Library

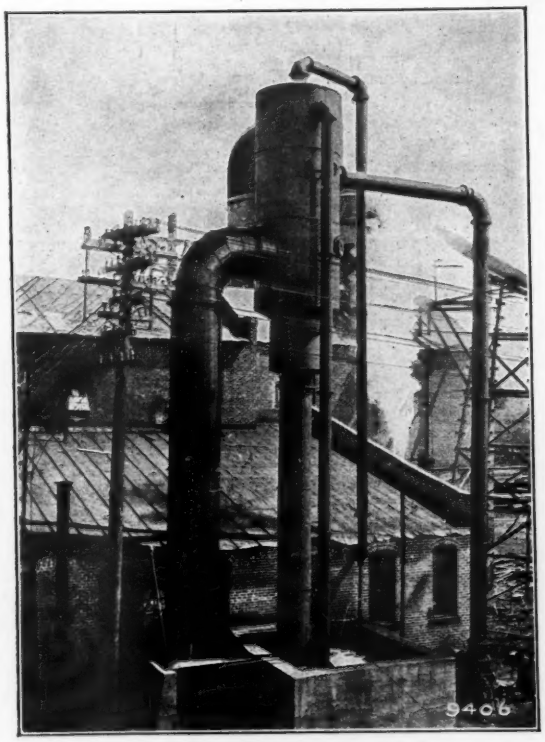
COMPRESSED AIR MAGAZINE

DEVOTED TO THE USEFUL APPLICATIONS OF COMPRESSED AIR

Vol. XXI NOVEMBER. 1916. No. 11

STEAM CONDENSING PLANT

Lyon Cypress Lumber Company, Caryville, La.



This Beyer Barometric Condenser was installed to serve a 1500 K. W. G. E. Mixed Pressure Turbo Generator. It maintains a 28° vacuum with 86° cooling water.

The circulating water is taken from the mill log-pond and elevated to the condenser by means of a Cameron Motor Driven Centrifugal Pump.

The Hot well of the Condenser is elevated so that the hot water flows by gravity to a walled-off section of the log-pond. From this basin it is forced through a spray cooling system by a second Cameron Motor Driven Centrifugal Pump.

The condenser is served by an "Ingersoll - Rogler" Steam Driven Dry Air Pump.

Ask for New Bulletin No. 9024.

The Ingersoll-Rand Company is prepared to quote on complete barometric condensing plants.

NEW YORK **INGERSOLL-RAND COMPANY** LONDON

OVER 15,000 COPIES THIS ISSUE

Published by THE COMPRESSED AIR MAGAZINE CO., Easton, Pa.

NEW YORK, Bowling Green Building LONDON, 165 Queen Victoria Street

Classified Buyers' Guide, Page 14. Index to Advertisers, Page 8.

Adopted as Standard
By Structural Steel Companies

GOODRICH
Pneumatic Tool Hose

The most sturdy, dependable, long-lived hose for continuous service where external wear is the hardest.

Frankly, we ask you—what better method could steel companies employ when establishing a standard on pneumatic hose than to test out all makes, letting service given govern their final selection?

Goodrich Pneumatic Tool Hose "takes everything" in service. Made by the makers of Silvertown Cord Tires —winners of every important racing event since 1914.

Also the makers of

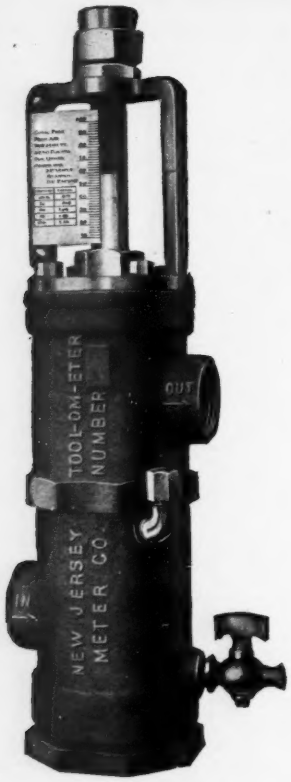
Air Drill — Pneumatic — Steam — Suction Hose

"Everything that's Best in Rubber"

THE B. F. GOODRICH COMPANY

Branches and Distributors in All Districts

Factories: AKRON, OHIO



NEW JERSEY AIR METERS

Read direct on a scale, in cubic feet of free air per minute, the flow of air in a pipe or hose. They show the consumption of any tool, drill, apparatus or process run by compressed air; determine the actual net capacity of a compressor or pump; detect losses due to leaks, wear, poor adjustment and inefficient apparatus.

TOOL-OM-ETER

10 to 100 feet per minute.

DRILL-OM-ETER

50 to 300 feet per minute.

Other sizes for all pressures and volumes.
State your requirements and write for Bulletin 5-A.

FOREIGN AGENTS

American Trading Co., Yokohama, Tokio.

Canadian Ingersoll-Rand Co., Montreal.

Ingersoll-Rand Co. London, Johannesburg, Melbourne.

NEW JERSEY METER CO.

PLAINFIELD, NEW JERSEY

COMPRESSED AIR MAGAZINE

EVERYTHING PNEUMATIC.

Vol. XXI NOVEMBER, 1916 No. 11

RADIAL PUNCHER AT WORK.

MINING THIN COAL BEDS WITH AIR PUNCHERS

BY S. W. SYMONS

My attention has been called to a published inquiry as to how best to mine thin coal beds. As a partial answer to this it will be proper to show how this is actually done in some of the bituminous mines, where thin beds are worked and where compressed air is employed. A knowledge of some of the methods that have recently come into use for mining anthracite also may prove of interest.

A device frequently employed for thin beds in bituminous mines is the "radial" type of mounted pick machine, with which the readers are more or less familiar. Beds as thin as 2 ft. have been mined successfully in Europe with machines of this type. The general method of mining is to undercut to a depth of 5 or 6 ft., and sometimes, as in the case of bad

roof, to overcut the coal, after which it can be broken down in the usual manner, using about 1 hole in every 9 or 10 ft. of face and two to three sticks of explosive in each hole. The number of holes or the amount of powder can be reduced when the coal is overcut, but this is only warranted when the roof is in bad shape, or when by so doing it becomes possible to eliminate timbering.

The radial puncher is made in two styles, one operated by compressed air and the other by electricity. The compressed-air type can be operated from a small portable plant mounted on a mine car. Some of these portable outfits are becoming popular in the anthracite district. The compressed-air machine is lighter and more easily handled than the electric type, though it consumes slightly more power.

It is impossible to make any definite statement as to the coal-cutting capacity of the radial type of puncher, 200 to 300 sq. ft. of cutting per 8-hr. day being considered a fair average for fairly hard coal. But in lignite, in a Canadian mine, with one of the latest types of radial machines, as high as 180 sq. ft. per hr. of actual cutting time has been recorded.

The beds of anthracite coal mentioned above carry a shale parting, which is cut out by the radial puncher. To do this two cuts are required, a bottom and a top cut, after which the intervening portion can readily be broken out. Or, if the material separates freely, a single cut at the bottom will suffice and a hand or pneumatic pick may be employed to bring down the coal. There appear to be no adequate records available of the speed to be expected in shale, but it is doubtful if there is a machine other than the air puncher which could handle it to equal advantage.

This method of mining, besides eliminating the shale and leaving the coal intact, has the effect of reducing the number of shot holes and the amount of powder necessary.

In mining anthracite, and also, to a limited extent, in bituminous operations, the air-driven Jackhamer drill is often employed for boring shot holes. This has been brought about by the ever-increasing demand for greater production. One particular instance is that of the St. Louis, Rocky Mountain and Pacific Co., of Koehler, N. M. In this mine the seam was 40 in. thick with an 8-in. parting 7 in. from the bottom. The parting (material unknown) was cut out with an air puncher, after which, in a 40-ft. room, it was necessary to place four shots in the top and bottom benches to loosen them properly for loading. The coal was hard and contained sulphur bands near the roof, which made drilling difficult.

A Jackhamer drill was installed and resulted in a doubling of the output, increasing the men's wages about 50 per cent. and making an actual saving of 9c. per ton, in addition to that resulting from increased production. Under test, six 4-ft. holes, 14 in. of each hole being through hard sulphur, were drilled in 20 min.—*Coal Age.*

DON'T USE COMPRESSED AIR FOR THE WORK

"Because of hard spots in the stock and unevenness of the circumference in cutting off bar stock, the tool may cut very irregularly as ordinarily fed. Not only that, but the hard spots are severe on the tool. Forcing the cutter into the work by means of a compressed air cylinder obviates both these difficulties. The air is just elastic enough to permit the tool to give a trifle when it strikes a hard spot."

The above we find in a recent issue of *Factory* which offers much good advice upon the details of shop and business management. In this case, however, we cannot agree with it, and much as we believe in compressed air we cannot think it wise to advocate its use for purposes to which it is not adapted. The writer as a latheman of long experience would say that a cutting off tool should have a positive and unyielding feed. If it were allowed as suggested to dodge the hard place the first time around it would have to dodge twice as much the second time around and so on. After a time it would be apt to get tired of this dodging and when the hard spot approached again it would dig in and you would have a broken tool. If at the beginning the circumference was irregular the tool should not cut all the way round but only cut the high spots until they came down to the low spots and then there would be continuous cutting.

An ordinary canvas cover is not a tarpaulin, but a paulin. Five parts coal tar, one part gasolene and our part good japan dryer, makes a good water-tight coating for canvas.

PNEUMATIC TAMPING REDUCES TRACK GANGS

BY H. L. HICKS

The development of the pneumatic tie tamper was the natural outgrowth of a demand for a mechanical device that would reduce the cost of ballasting track. The pneumatic tamper has now been in use for about a year and a half on electric railway work, and from the results obtained it is safe to say that this type of machine has come to stay. Its use is already wide-spread and it is not idle fancy that warrants the prediction that the pneumatic tie tamper will in the course of time practically supersede all hand tamping.

The pneumatic tie tamper, as its name signifies, operates on compressed air. It is a percussive tool similar in action to the pneumatic riveting hammer. The tamper, Fig. 1, consists of a barrel section, containing a free moving piston, a suitable extended handle with grips for holding it and a tamping bar. The last is inserted in the end of the barrel and is loosely held in place by a retainer fitting over a collar on the tamping bar itself. The piston reciprocates rapidly and delivers a succession of blows on the upper end of the tamping bar which in turn transmits the impact to the ballast.

FIG. 1.

THE TAMPING OPERATION

Pneumatic tie tampers are operated in pairs, Fig. 2, one tamper on each side of a tie. Their weight, 37½ lb. each, is sufficient to feed the tools down as the ballast is forced under the tie. All that is required of the operators is to hold and guide the machines. The tamping bars rest on the ballast and force it down and under the tie. In starting, these tampers are held vertical with the broad faces of the tamping bars parallel with the tie. This position is maintained until the bottom of the tie is reached when they are swung outward until at the proper angle to force the ballast under the center of the tie.

FIG. 2.

In the operation of the pneumatic tamper the tamping bar is practically stationary, transmitting to the ballast the rapid blows received from the piston. The absence of reciprocating motion makes the guidance of the machine an easy matter. The operator is able to avoid striking and injuring the ties and can guide the tamping bar in between switch points, cross-overs and similar places where he could not swing a pick or wield a tamping bar. It has also been a matter of observation that the pneumatic tamper does not crush the ballasting material.

The pneumatic tamper operates most efficiently on air at 65 lb. to 75 lb. pressure. In terminal yards and on systems where electro-pneumatic signals are used it has been found both convenient and entirely practical to use air from the signal service line, as the small amount used does not impair the operation of the signals. In ordinary traction work air is supplied from a portable compressor, usually electric driven. The customary provision of 300 ft. of hose gives a large working radius without moving the compressor.

While the pneumatic tie tamper works in any kind of ballast it is advisable to change the dimensions of the tamping bar face to suit the size of ballast and thus secure maximum effect from the available power. In crushed stone, 2 in. or over in size, a bar with a face 3 in. x ⅝ in. gives best satisfaction; with smaller stone or gravel a tamping face 3 in. x ⅞ in. is most effective and in tamping sand, dirt or cinders a still larger face, 3 in. x 1⅛ in. secures the greatest efficiency.

VARIOUS TAMPING EXPERIENCES

It is interesting to note the experiences of several electric railways with the pneumatic

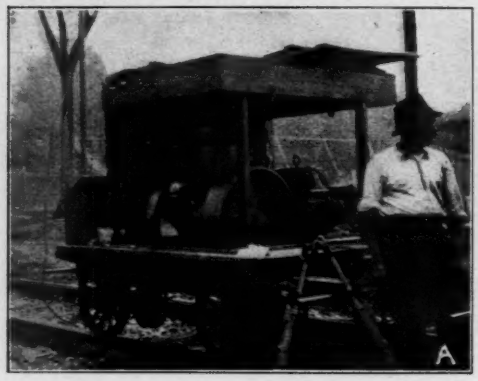


FIG. 3.

tamping machines. The Public Service Railway of New Jersey in extending its trackage in East Orange started tamping with two pneumatic tampers, Fig. 3, operated from a portable compressor. The average day's work of three men, two tampers and a shoveler, was sixty ties tamped on both sides for their whole length. Two-inch stone ballast was used and the track lifted 6 in. The foreman's comment to the writer was that ten men hand tamping might beat the two machines but six men could not keep up with them. To expedite still further the construction work an additional double unit of two pairs of tampers, operated from a similar compressor of large size, was placed in operation, Fig. 4.

At Minneapolis the Twin City Rapid Transit Company prepares the roadbed for new track by grading with a steam shovel, dumping in stone ballast and rolling it smooth with a steam roller. A layer of gravel is then added, the ties and track are laid and sand gravel ballast dumped in for tamping. Observations show that on this work two men, Fig. 5, with

FIG. 4.

FIG. 5.

pneumatic tampers do the work of eight men, Fig. 6, who formerly did tamping by hand. The average time required to tamp the full length of a tie on both sides is one and one-quarter minutes. When the operators noticed that their work was being timed they made a record of three-quarters of a minute. One of the most striking features of the work done here was a demonstration, Fig. 7, that a tamper could be operated by a one-armed man. The discovery was gratifying, not only to the individual but to the company on which he was dependent.

Thomas Crimmins & Sons, contractors for the laying and ballasting of the track on the

FIG. 6.

FIG. 7.

concrete viaduct of the rapid transit system extension in Queens Borough, New York City, used four pneumatic tampers, Fig. 8, operated from a gasoline driven compressor. The conditions here were rather unusual. The concrete structure had been filled between the sidewalls with 3-in. crushed stone, the depth varying from 5 to 10 ft. This was covered with a 3-in. layer of 2-in. stone, the track then laid and 2-in. stone ballast of an average depth of 12 in. dumped on for tamping. This construction necessitated very thorough work on the part of the tamping machines, to secure a permanently stable road-bed. An average of 550 ft. of track or about 367 ties per day were pneumatically tamped by a gang consisting of four men operating the tampers, two men shoveling ballast and four jacking up and aligning track.

On one of the lines of the Indianapolis Traction & Terminal Company, Indianapolis, Ind., the failure of continuous welded track due to excessive warping made relaying necessary. After employing six men shovel-tamping the dirt gravel ballast two pneumatic tampers were tried out and found to do more work than the hand labor, which they replaced. While the time record of their performance was variable due to the necessary delays in replacing the warped rails, their efficiency of operation was very satisfying to the company. For supplying compressed air to the tampers a standard straight line Ingersoll-Rogler compressor was mounted on a heavy construction wagon together with a short-belted electric motor and air receiver.

COMPARISON WITH HAND WORK

Investigation of results seems to justify the claims that machine tamped track is of greater stability and permanence than hand tamped track. The results obtained by the New York Central may be of interest as an indication of the quality of the work done by this type of machine. As a test 800 ft. of track was machine tamped and a similar length hand tamped. At the end of six months the comparative stability was measured with the following results:

	Hand	Machine
Greatest Settlement...	0.116 ft.	0.063 ft.
Least Settlement.....	0.018	0.004
Average Settlement...	0.067	0.033

This experiment was conducted on track over the Hackensack Meadows, New Jersey, where the foundation was soft, and for that reason not the ideal place for the purpose. The comparative results observed have been unofficially verified in electric railway work but exact figures have not been compiled.

FIG. 8.

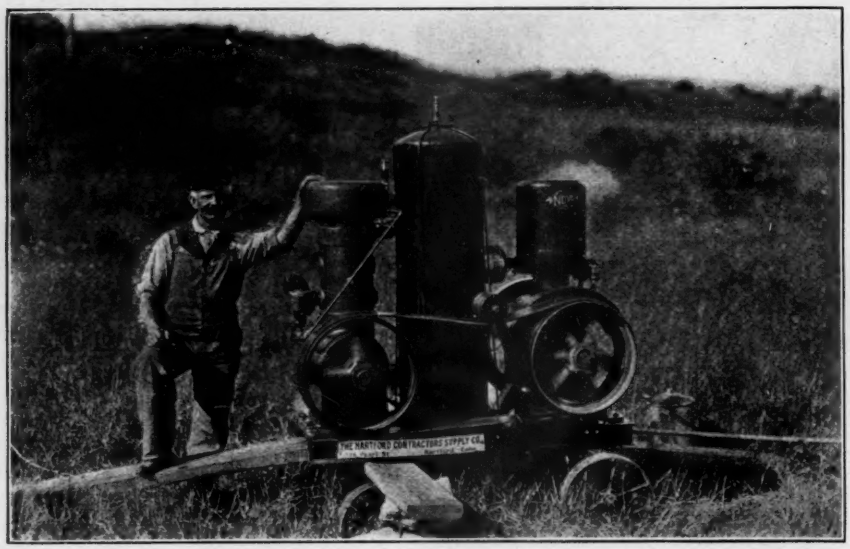


FIG. I.

CONTRACTORS' PORTABLE AIR COMPRESSORS

The interesting half-tones here presented show examples of a new line of portable, self-contained air compressing outfits as engaged in actual work. These compressors are put out by the Hartford Contractors' Supply Company and are built of various capacities and with gasoline, electric or steam drive as may be required. The type shown in our present illustrations is known as the Hartford OH. Compressor.

It comprises a Novo 6 h.p. gasoline engine, self-contained and frost proof, and an Ingersoll- Rand, Type XII compressor, 4½ by 5 in., belt driven, with a floating idler pulley to maintain the proper working tension. The capacity of the compressor is 23 cu. ft. of free air per min. which is sufficient for drills of the hammer type which are now almost

FIG. 2.

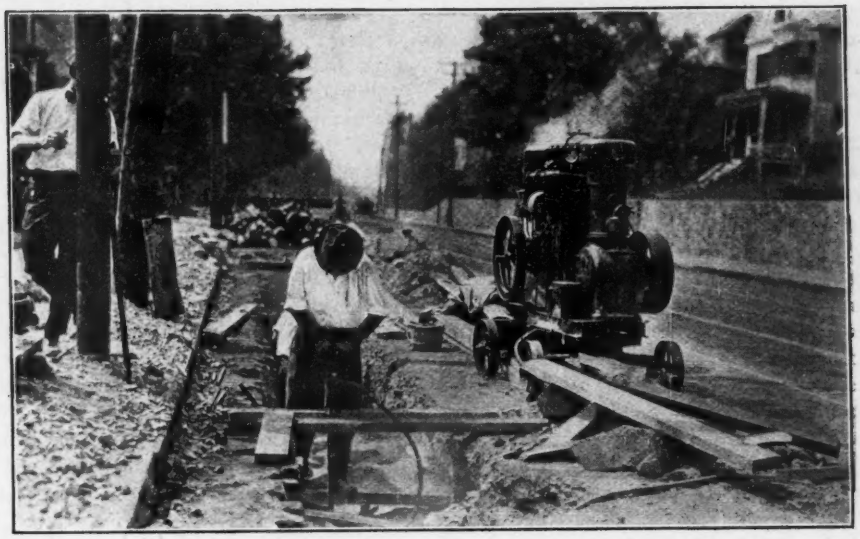


FIG. 3.

exclusively used by contractors. The cooling system employed on both compressor and engine is a self-contained reservoir, no tanks; the compressor has automatic unloader, relief valve and pressure gage and is also automatically lubricated. The air receiver is of ample capacity, 5 ft. by 16 in. and is provided with all connections and appurtenances. The truck, of heavy channel iron, is mounted on "Electric" wheels, and a swinging handle provides for drawing about by hand. If the compressor is to be handled over rough roads it can be furnished with heavier mounting and pole or shafts for horses.

The compressor shown running in Fig. 1 is in the service of the Guilford-Cluster Water Company, Connecticut. The drill, Fig. 2, 250 ft. from the machine, is putting down 5 ft. holes in hard rock at the rate of 1 ft. in 8 min.

A similar compressor seen in Fig. 3 is work-

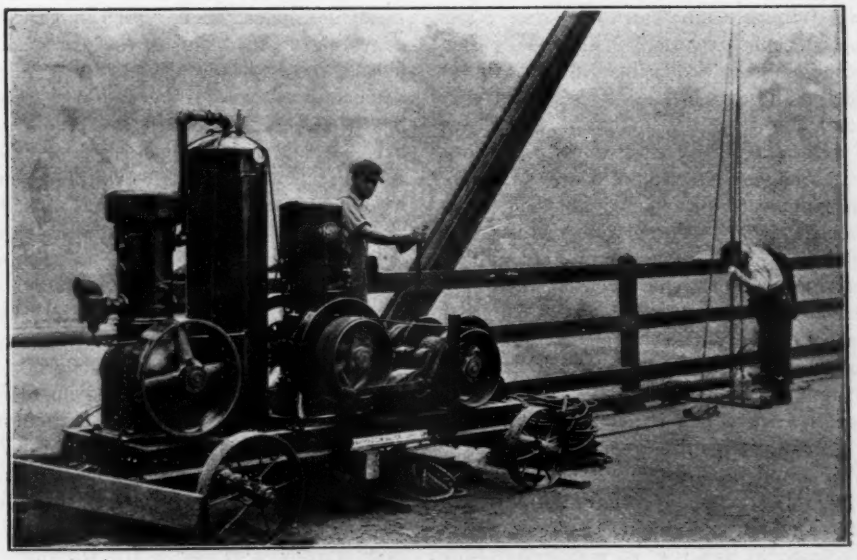


FIG. 4.

ing at Melrose, Mass., for the Fred T. Ley Company, Springfield, Mass., drilling flint rock preparatory to laying conduits. The builders state that the performance of this plant was so satisfactory that a duplicate order was immediately placed for shipment to Salem, Mass., to drill holes of special size, 3 ft. deep and bottoming at 2 in. diameter.

Fig. 4 shows a special adaptation of the OH. Compressor designed and built for the Connecticut State Highway Department. As here shown it is being used in the reconstruction of a 150 ft. steel bridge at Sandy Hook, Conn. The combination is ideal for the variety of operations in such an undertaking. It does all the hoisting called for, drives the rotating drills for steel, riveting hammer, holder on, calking, etc., and is of course always ready for rock drill work. The machine stands and works anywhere without blocking. It should be noted that the boom seen in the half-tone is not a part of the machine. The rope runs out horizontally from the hoisting drum to snatch-block secured to the deck.

THE TUNNELLING HEROES OF THE WAR

The following is extracted from an article by a mining engineer who is on the job.

The first companies organized for tunnelling work were enrolled from miners who were at the outset enlisted as ordinary soldiers, and were already trained men in France. Later on special companies were organized in England, and enlisted from the different mining districts in the British Isles. These men were sent out with very little military training, but they were experts at their own speciality, namely, mining. Their officers are, as a rule, mining engineers, who have knocked about all over the world. These were men who, in peace time, were making anything from £500 to £3,000 a year, but who threw up their jobs and came back to England at their country's call, enlisting, very often as privates, so as to get some knowledge of military work, and then when the call came for tunnelling officers they applied for and got their commissions in these specially organized companies. There are also a number of officers, younger men, who have just passed through the different schools of mines, and obtained commissions in these companies, and it is no uncommon thing to see a man of between 40 and 50, grey and tanned by many a hard year's work in the tropics, laboring as a second lieutenant under a youngster of 22 years of age, but it is all taken in good part as it is just one way of doing their bit, hard, at times, no doubt, but all have to swallow many old prejudices now-a-days.

The tunnellers are Royal Engineers, and wear that motto "Ubique" (for the general good), but perhaps a better motto for them would be "Guard the Infantry," for in trench warfare that is their all-important duty. If the enemy explodes a big mine near our front line, the first question asked the officer-in-charge at the time by his superior is: "Lost any infantry," and if any are lost careful enquiry is made as to how it happened no warning could be given. The second question will be: "Lost any of our own men," and if so a shrug of the shoulders follows, which means: "Well, its the fortune of war, we must expect to lose some men."

The work of the tunnelling companies is always interesting. They are continually at work, and the danger is ever present. The men are always, as it were, "up against it," and the essence and value of what they do lies in absolutely quiet working, so as to give the enemy as little indication of their whereabouts as possible, and also to preserve secrecy as to their work and methods.

In the trenches they work by the light of a candle "stripped to the buff," with the knowledge that at any moment the enemy, who, as a rule, can hear the picking going on, and is often only a few feet away from them, may fire a defensive mine and put them out for ever. Again, after an enemy's mine explosion, or even when one of their own mines has been exploded, the miner may drift through the strata, often several days after the explosion, and before he realizes that he is working in a deadly atmosphere in which he may be rendered unconscious, and unless very speedily rescued die of gas poisoning.

He may also sit silent and alone in a listening gallery with nerves trained up to concert pitch listening to catch every faint indication of the position of the enemy, and trying to piece together, from every slight noise, what "the man on the other side of the wall" is up to. A nerve-trying job this, in a long, dark gallery 4 ft. by 2 ft., without even a candle, but a tunneller must have no nerves.

Away out in front of our front line, right out in "No Man's Land," down under anything from 30 to 150 ft. from surface, sit or lie that line of silent sentries. Those silent guardians of our front line trenches are really and truly our first line of defence. Silent, but ever watchful, with ears trained by experience, and nerves hardened by years of work in the mining districts at home, these men do their invaluable work. Our Colonies have also organized and sent out to us tunnelling companies. There also work there strong, silent men, the men who made this defensive line, and who are now working to carry their galleries under the lines of the Huns themselves, for in offensive, as well as in defensive, work it is a case of "Guard the infantry."

If a bombing raid or an attack in force is made on any part of the enemy's line it is generally preceded by a series of mine explosions under their front line, for the successful working of which the mining company is responsible.

Ask the infantry if they "go over" after a series of mine explosions what do they find. They find demolished trenches, dead men, and demoralized men, instead of machine guns prepared to pour their deadly hail of bullets into unshaken men ready and waiting to decimate their ranks. So in the offensive, as well as in the defensive, the cry is "Guard the infantry."

Just one case, put as shortly and crudely as possible, but a true case. Four mines were to go under the enemy's lines on a certain date and at a certain time. Fairly stiff clay, but for the eight out of ten days they had to do it in, the men on each gallery did their 30 ft. a day in eight-hour shifts, galleries 4 ft. by 2 ft., not a stick of timber, not a sound, with feet cased in sandbags to prevent noise and preserve absolute silence. The sound of the tramping feet above them told them they were under the Hun lines. One gallery broke into a Hun gallery close to their lines, where they were working, but the hole was plugged up and a pipe put in. For two days our interpreters listened to the conversation of the enemy's miners while silently but quickly explosives were brought along the galleries. At length the men "tamped up" right alongside where the enemy was working, and still remained undiscovered. Wires were trained up the shafts, batteries tested, and everything went according to time to the very minute.

The British public seldom stop to think, when they read that small and laconic notice in a paper: "We exploded a mine at ——, and occupied the crater," of the preceding work and anxiety entailed upon the officers and men "down under." The tuneller's reward is that the infantry, in common with the higher command, know what they owe to the tunnellers. I have seen a tunnelling officer come back after a "Push" of this sort dead-beat himself, wet, cold, and plastered with mud, with "My God! every one of these men of mine deserves the V.C., they've behaved splendidly.

WIND CAVE

Wind Cave in the Black Hills, National Park, South Dakota, on the Denver-Deadwood scenic highway and about twelve miles from Hot Springs, is claimed by enthusiasts to excel the Mammoth Cave of Kentucky in splendors and in extent. Half a dozen government surveys have been made in the park. These and various private exploring expeditions that have been organized have accounted for some 96 miles of the recesses of Wind Cave, but there are hundreds of passageways that have never been explored. No one knows to what depths they lead, or how far under the Black Hills they may take the explorer. The average visitor to Wind Cave, National Park, travels from six to ten miles underground and comes forth into the daylight realizing that he has seen but a small fraction of this great cavern.

Wind Cave takes its name from the strong current of air which almost constantly surges inward or outward at the entrance, this phenomenon having led to the discovery of the cave in 1881. There have been many speculations as to the cause of the air movements, but a very plausible explanation is easily suggested. The cave, as is evident, contains an immense volume of air which we may assume normally corresponds in pressure to the mean pressure of the atmosphere outside the cave. There is nothing within the cave to change the pressure of the air, while the pressure of the atmosphere outside is constantly changing, as indicated by the barometer. It would be quite natural to expect, therefore, that with a falling barometer there would be a rush of air out of the cave, while with a rising barometer the rush would be into the cave until, in either case, the pressures within and without the cave would be temporarily equalized.

PRINCIPLES OF REFRIGERATING SYSTEMS

BY M. A. SAHLER

When a substance passes from the liquid to the gaseous state, the change is always accompanied by the absorption of heat, which is commonly called the latent heat, *i. e.*, the hidden heat which cannot be measured with a thermometer. For instance, when water is heated under atmospheric pressure the temperature will rise until it reaches 212 degrees. Further heating of the water at 212 degrees will change it into steam at 212 degrees. The heat which is absorbed while the water is being changed from liquid to steam is the latent heat, or the heat of evaporation. This law, to the effect that a substance passing from liquid to gaseous form must absorb heat, is taken advantage of for producing refrigeration, by making use of volatile liquids which absorb and give up their latent heat quickly and freely.

REFRIGERATING AGENTS

The three agents most generally used for refrigerating purposes are anhydrous ammonia, carbon dioxide and sulphur dioxide. Three desirable features in a refrigerating agent are, low boiling point, so that it gives up its heat at low pressures, permitting the use of light machinery and making it less difficult to prevent leakage; and low specific volume, so that less cumbersome apparatus is required; also great latent heat, resulting in great refrigerating capacity.

Anhydrous ammonia is the most widely used. This has a boiling point of 28 degrees below zero, a latent heat of 573 B.t.u., and a specific volume of 4.4. The main disadvantage of ammonia is that it corrodes brass and copper, and consequently all piping and fittings must be made of iron and steel. Leakage of ammonia in large quantities is also dangerous to human life.

Carbon dioxide has a boiling point of 110 degrees below zero, a latent heat of 140 degrees and a specific volume of 1. The chief advantage of this is that it is non-inflammable, non-explosive, and not dangerous to human life unless present in very large quantities. The main disadvantag is the high pressure which is required to liquefy it, this running from 750 to 1,000 pounds. The carbon dioxide machine is suitable for small compact intallations, and because of this and its inoffensive odor, it is widely used on shipboard. It is also non-corrosive.

Sulphur dioxide, or sulphurous acid, has a boiling point of 14 degrees below zero, a latent heat of 162 degrees and a specific volume of 13. The main advantage is that it liquefies at very low pressures, but this advantage is offset by the fact of its high specific volume which requires large cumbersome machinery. Air leakage into such a system results in the formation of sulphuric acid which is extremely corrosive.

COMPRESSION SYSTEM

In the compression system the compressor takes the ammonia which has been evaporated in the expansion coils in the tank and forces this vapor under pressure into the condenser, and when it strikes the cool surfaces of the condenser, cooled by means of cold water circulating over the tubes of the condenser, the gas gives up the heat which it has absorbed in the expansion coils and is condensed into liquid form. The liquid ammonia thus produced then passes to a liquid receiver from which it is admitted as desired, through a throttle valve, into the expansion coils, where it again begins to evaporate and consequently absorbs heat, and gas is pumped out of the coils by the compressor, passes to the condenser, is condensed, and thus goes around the circuit indefinitely.

The compressor does not change the vapor into liquid, but merely reduces its volume and thus increases its temperature, *i. e.*, the latent heat which is taken up in the process of evaporation in the expansion coils is changed into sensible heat at the high pressure, and this sensible heat is then given up to the cooling water in the condenser. The degree to which the ammonia vapor is compressed depends on the temperature of the water used in the condenser.

Where all the ammonia is evaporated into gas in the expansion coils, and returns to the compressor, it is called the dry system. Where some of the ammonia after passing through the expansion coils is in liquid form, the liquid being caught in a trap or accumulator, and repassed through the coils, while the gas is separated from it and returned to the compressor, it is called the flooded system.

In the dry system the heat is transferred from the liquid outside the coils to the gas

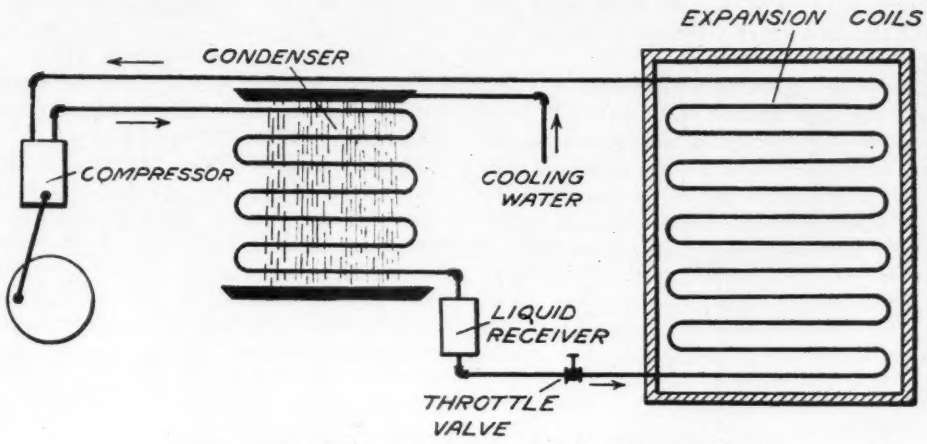


FIG. I. COURSE OF THE AMMONIA IN A COMPRESSION SYSTEM.

inside the coils, while in the flooded system the heat transmission is between liquid on both sides of the coils, and since the transmission of the heat from a liquid to a liquid is much more rapid than from a gas to a liquid more rapid refrigeration can be obtained with the flooded system, and for a given capacity less refigerating surface is required, or for a given refrigeration surface greater capacity is secured. The flooded system requires less evaporating surface than the dry system, but it requires a greater initial amount of ammonia, although a smaller compressor may be used.

ABSORPTION SYSTEM

The principle involved in the absorption system is the absorption and repulsion of ammonia gas by alternate cooling and heating, water being used as the absorbing medium. The refrigerating agent is aqua ammonia or ammonia water, a mixture of anhydrous ammonia and water in the proportions of about one and two, respectively. This ammonia water is placed in a generator, where it is heated by steam coils containing low pressure steam, usually the exhaust from the circulating pump, and due to this heat ammonia gas under

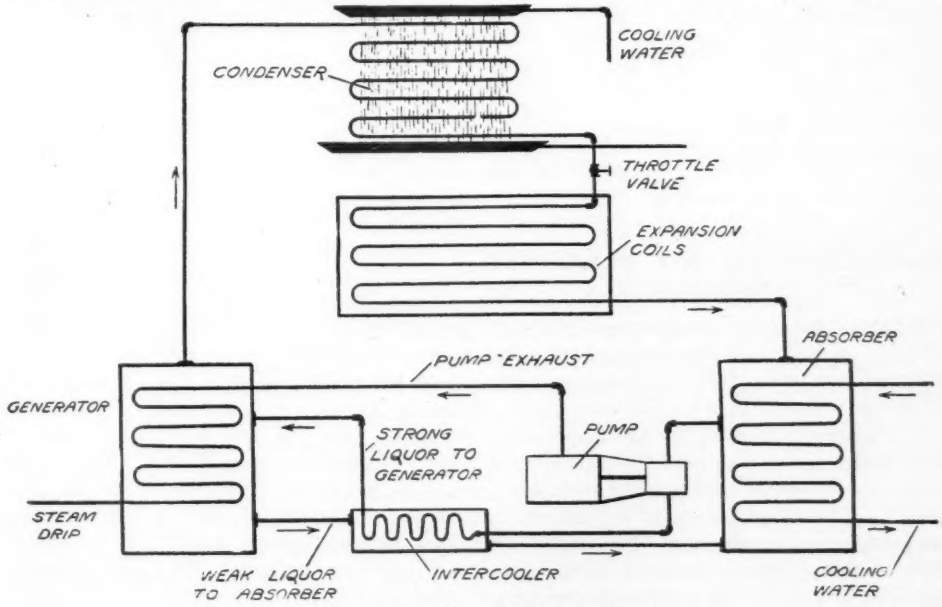


FIG. 2. DIAGRAM OF ABSORPTION SYSTEM.

pressure is liberated from the water and passes on to the condenser where it is cooled and liquefied.

The liquid ammonia then passes into the expansion coils, and the warm gas from these flows into an absorber, a tank containing the weak aqua ammonia, *i. e.*, that which has previously given up its gas in the generator. In the absorber are coils containing cold water, and the ammonia vapor coming from the expansion coils is absorbed by this weak aqua ammonia, and the heat given up by the gas in the absorption process is carried off in the cooling water. The strong liquor or strong aqua ammonia resulting from the absorption of the ammonia gas is pumped into the generator where it is again driven out of solution by the heating coils, and so around the cycle indefinitely.

The strong liquor going to the generator passes on one side of a set of coils, while the weak liquor from the generator to the absorber passes on the other side of the coils. Hence some of the heat in the weak liquor is given up to the cooler strong liquor going to the generator. This interchange of heat relieves the generator and absorber of just so much work, and increases the capacity and efficiency of the apparatus. These intercooling coils are called interchangers or intercoolers.

The main advantage of the absorption system is that the only power required is that necessary to circulate the liquor from the absorber to the generator, and this is usually done by a steam pump, the exhaust of which is utilized in the generator. However, a greater amount of cooling water is required, since cooling water is not only required for the condenser but in the absorber.

COMPRESSED AIR FOR PERPETUAL MOTION

We do not know why compressed air should not be as good as anything for the use of the perpetual inventor of perpetual motion. The following is from a local paper:

Mr. Charles H. Winne, of this city, has recently completed the invention of a device on which he has been at work for the past eleven years. This device consists of an air motor, which the inventor claims may be installed on manufacturing plants, vessels and railway cars, and claims that by its use power will cost nothing after the cost of installing the machine In other words those who install machines after the pattern of his invention will not be called upon to meet monthly bills for electric current as most manufacturers and others who use electric power do to-day.

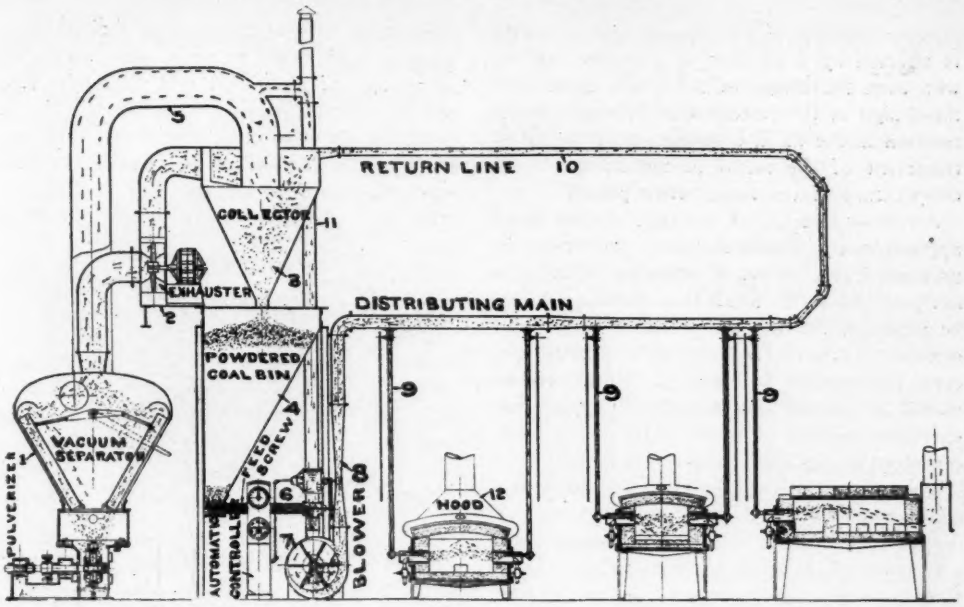
Through a well known Washington firm of patent attorneys, Mr. Winne has filed an application for a patent on his invention with the United States patent office, and is hoping for favorable action on it. The device consists, roughly speaking, of a large revolving wheel which will be kept in perpetual motion through air pressure, currents of air being led to the wheel through a series of conduits, so arranged that a strong draft or suction is possible at all times.

It must not be taken from the above description that the device is patterned after a common windmill, which requires that wind shall be blowing in order to maintain its operation. On the other hand the motor can be operated on days when not a breath of air is stirring just as well as on days when the wind is blowing a gale, though on the latter days the amount of current which the device will generate will be greater than when there is little or no air stirring.

The motor is so protected that no matter what the weather may be, no rain or moisture will enter the casing to impair the efficiency of the apparatus. It is the inventor's claim that the air currents will drive the wheel around at a speed sufficient to generate an even current of electricity, and he further states that practical tests to which he has subjected the device have proven to his satisfaction that it will do all that he claims for it.

NOVEL COAL DUST EXPLOSION

A steam plant had occasion to use as a poker a 10-foot rod made of heavy tubing, one end of which had been hammered together, the other end being open. The open end was always thrust back into the coal pile after using with the result that some finely powdered coal found its way inside. It was decided, however, to close the other end also. The next time the poker was used to any extent there was a terrific explosion that tore the poker apart and hurled the fireman against the boiler. It was thought that a quantity of the powdered coal remained in the tube.—*Electrical World.*



A PNEUMATIC SYSTEM FOR BURNING POWDERED COAL

The cut on this page shows diagrammatically the essential features of a pneumatic system especially adapted to the requirements of metal heating furnaces which has been developed by A. A. Holbeck of the Bonnot Company, Canton, Ohio. The installation of this system makes it possible to distribute the fuel to a number of widely separated furnaces, the coal pulverizing plant being necessarily located some distance from either.

Bituminous crushed, nut or slack coal is stored in a bin, preferably made of steel or concrete. The coal passes from the bin and an automatic feeder regulates the amount of coal fed to the pulverizer, shown at the extreme left. As the coal becomes pulverized it is thrown up into the vacuum separator 1 by the action of the pulverizer. This separator separates the fine particles of coal dust from the coarse, the finest being drawn into the exhauster 2, the coarse falling down into the pulverizer.

From the exhauster 2 the powdered coal is blown into the collector 3. The expansion of the air as it enters the collector permits the coal dust that is carried in suspension to fall to the bottom of the collector and into the coal storage tank 4. The air that enters the collector returns through pipe 5 to the pulverizer to be used over again.

The coal dust is taken from the storage tank 4 by the feed screw 6 and delivered into the suction side of high-pressure blower 7. It is then blown into the distributing main 8, and carried to the furnace through the distributing pipes 9.

The coal which is not used at the furnaces is returned through the return line 10 to the collector 3, where it is extracted from the air and falls into the coal storage tank 4 to be used over again.

The air after the coal is extracted is returned to the suction side of the blower through pipe 11. The products of combustion from the furnaces are collected by the hoods 12 placed in front of each furnace, and are disposed of either by means of an exhauster or a stack.

TO MAKE AIR TIGHT BRASS AND BRONZE CASTINGS

The following is from a paper before the American Institute of Metals, Cleveland, Sept., 1916, by S. D. Sleeth, superintendent of the foundries of the Westinghouse Air Brake Company, Wilmerding, Pa.

Density and strength are the two qualities necessary in a metal suitable for the retention of air or other gases under pressure, and while strength may be secured through proper design, density is a quality not so easy to

obtain. Density of a brass or bronze casting is affected by a number of variables, among which are the design of the article to be cast, the design of the pattern with reference to its position in the flask, composition of the alloy, treatment of the metal in the furnaces and temperature of the metal when poured.

All cross-sections of the part should be of approximately equal thickness in order to prevent draws of heavy portions. If this is not possible, access to all large sections should be provided for the use of chills to prevent draws. If the cored cavities are large, the cores themselves will act as chills. Fillets should be as small as possible in order that excessive masses of metal shall not be concentrated at one point.

The use of chills is almost always necessary. Chills should be used on all enlarged sections in close proximity to smaller sections and connected thereto. If the sections are exceptionally large, sinking heads on top of the large sections should be used. The molds should be gated with a heavy upright pouring gate as near the pattern as possible. The gate leading from the pouring gate to the pattern should be made large at the pouring gate and then reduced sharply into the pattern. If it is left large where it joins the pattern, in all probability it will show a draw in the casting at the gate. As a rule, it is better to gate in a light part of the casting than in a heavy portion. If a sinking head is used, it should be placed on the heavy part.

The treatment of the metal in the furnaces is of vital importance. If proper allowance for oxidization on zinc, etc., is not made, the alloy required will not be produced. The metal must be taken from the furnace as soon as it reaches the proper heat, for if allowed to soak in the furnace, it will take up gases, and the castings made from it may be porous. In pouring certain packing ring mixtures, the Westinghouse Air Brake Co. considers the time so important that an alarm clock is used to insure the metal being poured at exactly the right moment.

The temperature at which the metal should be poured is also vitally important; no doubt many castings are lost due to carelessness in this matter. If poured too cold, it is almost impossible to obtain solid castings, especially at the gates. On the other hand, if poured too hot, castings may be porous throughout. Great care must be taken to see that no aluminum is used in the mixture, as a very small percentage of aluminum will cause the castings to leak. Antimony and iron will do the same, but not to so great an extent. Aluminum has a peculiar action on the metal. The castings will appear solid and will not show a draw, but when under pressure will leak all over.

The following compositions have been tried and found satisfactory for air containers:

Metals	No. 1 Alloy	No. 2 Alloy	No. 3 Alloy
Copper	72.50	82.00	83.00
Tin	1.75	7.50	11.50
Zinc	19.25	4.75	4.00
Lead	6.50	5.75	1.50
Total	100.00	100.00	100.00

No. 1 alloy is used for ordinary castings, such as cocks, pistons, bushings, etc. It is easily machined, but is not suitable for very high pressures. No. 2 and No. 3 alloys are suitable for high pressures and are harder to machine than No. 1.

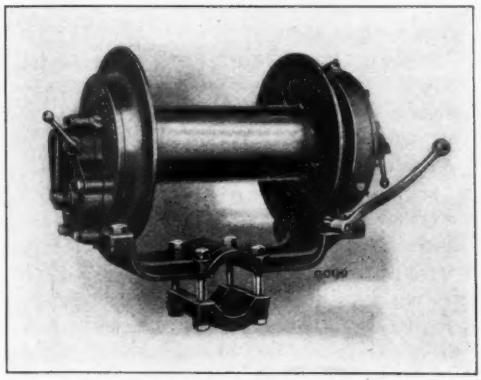
ROOSEVELT DRAINAGE TUNNEL RECORD

A remarkable record is being made in the driving of the Roosevelt drainage tunnel in the Cripple Creek mining district. The material is a hard volcanic breccia, with occasional dikes of basalt and phonolite, also very hard. The tunnel section is 9 ft. wide by 8ft. high in the clear, with a ditch or waterway at one side 4 ft. wide and 2 ft. deep.

The drills used are the Ingersoll-Leyner, Model 18, with 2¼ in. bits for starting. Two drills on a horizontal bar are worked in each shift. Usually it takes at least 30 holes to break a round. From 5 to 7 ft. only is broken per round. Little timbering is necessary, but water seems to come out of every fissure and crevice, the total flow at the portal now being 10,300 gal. per min. This makes it necessary for the men to wear heavy rubber boots and clothing. The rock is hauled from the face and hoisted out of the Elkton shaft.

The record for the 27 days worked in August, three shifts of eight men, was 437 feet. The best previous record was 400 ft. in January, 1909. The tunnel is four miles long now and it is intended to drive it 6,400 ft.

farther to the Golden Cycle shaft, although it is now rapidly draining the entire district. Charles F. Fuller is superintendent, and T. R. Countryman is chief engineer.



A NEW MODEL LITTLE TUGGER HOIST

For the use of those who prefer manila rope to wire rope for light hoisting and hauling, the Ingersoll-Rand Company has brought out a new model Little Tugger Hoist which is designated No. 11.

The square piston, reversible driving engine, automatic lubrication, enclosed gearing, drum release clutch and worm operated band brake are essentially the same as in the No. 1 model which has come into extensive use since its introduction a couple of years ago. The main differences are in the diameter and length of the drum, the width of the flanges and, necessarily, the main frame and over all dimensions.

The new No. 11 Little Tugger has a hoisting drum 7 inches in diameter by 17 inches long with 5 inch flanges. This accommodates 300 feet of ⅞ inch manila rope. The maximum capacity of this hoist is conservatively rated at 600 pounds. The weight of the hoist itself is 358 pounds. It is 21½ inches long, 31¼ inches wide and 23 inches high.

Like the No. 1, the No. 11 Little Tugger is built for operation either by compressed air or steam. The standard clamp fits a 4½" diameter column or pipe, but by removing the clamp the hoist can be readily bolted directly to any convenient support, timber, flooring, etc.

Although designed primarily for underground work it is recommended by the manufacturer for all around hoisting, hauling and handling in mines, tunnels, quarries and industrial plants.

DIVING HELMETS ALWAYS AT HAND

At page 8117 of our September issue was shown a novel application of the now practically obsolete diving bell which may lead to its rehabilitation, at least for emergency use. The diving bell in this case may be any open ended vessel inverted and resting on the shoulders. Air is led to it by a hose from any source and entirely regardless of its pressure so that it is not less than the pressure of the water at the depth to which it may at any time be submerged. The arrangement is so obvious that it should have been used years ago, and it is not easy to believe that it was not.

The illustrations here reproduced from *Engineering News*, show two applications of this device which were employed in emergency under-water work by J. J. Griffin, Engineer-Superintendent of the New York Dock Co., foot of Montague St., Brooklyn, N. Y. Fig. 1 shows the first of these and explains the work on which it was employed.

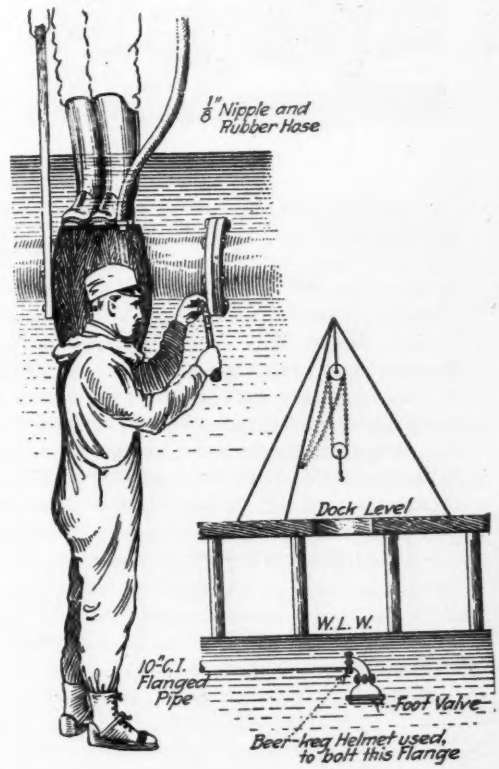


FIG. 1.

FIG. 2.

It was necessary under one of the wharves to connect up a 10-in. fire line—under water and in a limited time. It was impossible to do this from the wharf or from a boat, and a diving helmet was not available. A satisfactory helmet was obtained, however, by knocking one head from an empty beer keg. To steady the keg and overcome its buoyancy when submerged, a man stood on top, holding to a strip of wood that was nailed to the keg. With this extremely rough outfit it was possible for a man to stay down 1½ min., using only the air imprisoned in the keg. The pipe was bolted to the elbow successfully.

For later work on this same fire line a ⅛-in. brass nipple was fitted into the head of the keg, and to this was attached a rubber tube, through which air was forced by means of a common foot pump. With this arrangement—which was used only in shallow water—a man could stay down about 8 min.

Fig. 2 shows the next step in home-made diving helmets instituted by Mr. Grafflin. This arrangement is one end of an ordinary kitchen boiler notched to fit the shoulders and weighted with chain, as shown. With this rig and an ordinary duplex automobile pump it was possible to stay down 15 min. at a depth of 30 ft. The contrivance was used in the summer of 1914 to clear out in front of the intake to a 1,500-gal. per min. centrifugal fire pump located at the New York Dock Co.'s German-American stores.

In this outfit, as in the case of the keg, there was no window. This omission was not an item of importance, inasmuch as the sense of sight is of no service under the East River. Diving work there must ordinarily be done in the dark. As a general convenience, however, the boiler helmet was ultimately provided with a window, which was merely an oblong glass paperweight cemented to a hole cut in the front of the helmet. With the present rig (Fig. 3) and a regular deep-sea pump Mr. Grafflin has stayed down 1½ hr. This helmet was used in the summer of 1915 to excavate about 1½ yd. of silt and rock in 10 ft. of water, in a space not over 3x4 ft. in plan. The excavation was at the intake of the same centrifugal fire pump before mentioned and was to permit the installation of the screen in front of the intake (Fig. 4). Fig. 5 shows the screen in place and indicates the service it performs.

The rough helmet described has the advan-

FIG. 3.

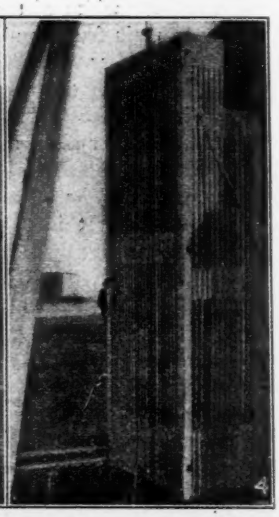


FIG. 4.

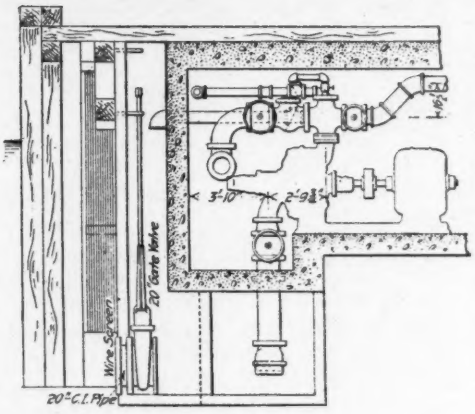


FIG. 5.

tage of occupying only about one-half the space of a regular helmet. The sandals were made by the company blacksmith from ¾x4-in. iron. They are provided with a ⅛x1½-in. strap across the toe and tied above the instep with sash cord.

scribed in the following paragraphs was devised.

The device consists of a two-compartment steel tank mounted on trucks to run on track of any gage. The tank, as shown in the accompanying drawing, is equipped with two valves *H* and *G*, and two short lengths of hose, each having a quick-connection coupling numbered 1 and 2. The tank is also equipped with a valve *I* at the rear to which is attached the pipe connections 3. These connections are drilled in such a manner as to make a spray when water is forced through them.

Where the valves *H* and *I* are connected to the tank, a pipe connection on the inside runs close to the bottom of the tank. Two pressure gages *C* and *D* are connected to the tank, one in each compartment. The tank is also equipped with a pressure-reducing valve *E* and a check valve *F*, which are connected to the tank by means of pipe and pipe connections 4 and 5. These connections are located on opposite sides of the partition that divides

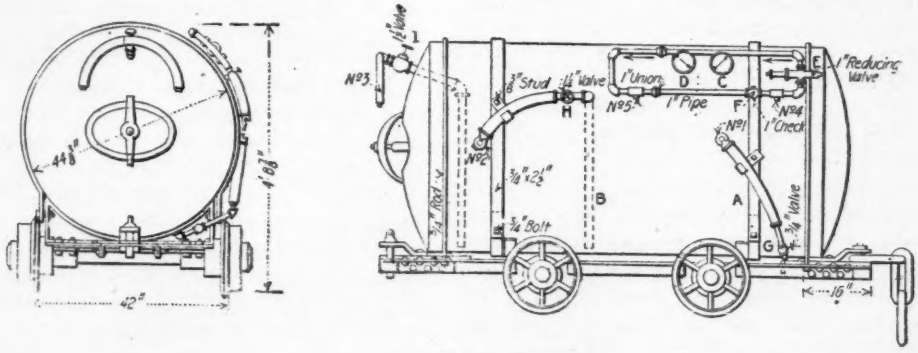


FIG. I.

AIR PRESSURE MINE SPRINKLING CAR

BY F. F. JORGENSEN

The ordinary type of sprinkling car used in mines is a wooden tank mounted on trucks, the tank having a large hole in one end at the bottom. Before filling the tank, a wooden plug is driven into this hole; and when the car reaches the piece of road to be sprinkled, the plug is removed. None of the dust except that between the rails is reached by the water, and that part is thoroughly soaked. This dust is usually not very harmful, for it is pretty well mixed with shale dust. The dangerous dust, of course, is on the ribs and timbers; and to reach this the sprinkler de-

the tank into the two air- and water-tight compartments *A* and *B*. Compartment *B* is equipped with a manhead to make it accessible for cleaning out and repair purposes.

The operation of the sprinkling tank car is as follows: Hose 1 is connected to a compressed-air supply line, and the valve on the supply line and the valve *G* are opened, admitting compressed air into compartment *A*. When the pressure in compartment *A* rises above the limit set by the reducing valve *E*, compressed air begins to flow through pipe connection 4, reducing valve *E* and pipe connection 5 into compartment *B*. When the pressure in compartment *B* reaches the limit set by the pressure-reducing valve *E*, the valve

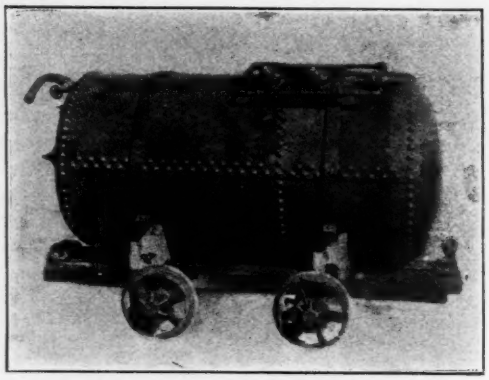


FIG. 2.

in the supply line and the valve *C* are closed, and the quick connection 1 is uncoupled. The limit set by the pressure-reducing valve may be anything desired, from zero up to the maximum pressure available in the supply line.

Connection is then made at 2 with the water-supply line. The valve in the water-supply line and the valve *H* are opened and water is admitted to compartment *B*. This water must be under great enough pressure to flow against the pressure in the tank. As the water flows into compartment *B* the air in this compartment is compressed and the pressure rises. When this pressure exceeds the pressure in compartment *A*, the air starts to flow from compartment *B* through connection 4, check valve *F* and pipe connection 5 into compartment *A*. When compartment *B* has filled with water, the valve in the supply line and valve *H* are closed, and connection 2 is uncoupled. The order of filling with air and water may be reversed; that is compartment *B* may be filled with water first and then compartment *A* filled with compressed air; but in this case the pressure of the compressed-air supply must be higher than in the first order of filling.

The tank is now ready to begin sprinkling. Both compartments *A* and *B* have the same pressure, but as soon as valve *I* is opened the pressure in compartment *B* drops to the pressure at which the pressure-reducing valve *E* is set. The air continues to pass from compartment *A* through the pressure-reducing valve *E* into compartment *B*, maintaining a constant pressure over the water in compartment *B* until the water in that compartment is forced out through sprinkler connection 3. The sprinkler 3 is so made and connected that the spray of water may be directed against the roof and sides of an entry, or in any other direction.

Any water getting over into the air compartment *A* when filling compartment *B* with water may be blown out through connection 1 by opening valve *G*.

The sprinkler may also be used for fire-fighting purposes, or any other purpose where water may be needed, by connecting the desired length of hose to connection 2 and opening the valve *H*. The accompanying photograph shows the tank, complete with all gages, valves and connections, mounted on a roller-bearing truck and ready for use. The car shown here has been in service for about nine months and has proved very satisfactory.

AIR PROPELLERS FOR BOATS

At first sight it might be considered that a propeller which revolves in the air can never be so efficient as one turning in the water where more resistance is offered, but there has during the past few years been a great advance in the design of aerial propellers, with the result that their efficiency is now fairly good, and may in certain cases exceed that of a submerged propeller. Their use as applied to motor-boats is still more or less in the experimental stage, and it is improbable that the best results have yet been attained; nevertheless, on comparative tests that have been carried out with the two types, it has sometimes been found that there is practically no difference in the speed of the boat whether a submerged or an aerial propeller be employed.

SPHERES OF APPLICATION

It may not at once be clear why there is any reason against the accepted means of propulsion, and in general it may be taken that the use of an aerial propeller is to be recommended only when there are special circumstances which render its employment specially desirable. Chief among its applications is perhaps in connection with shallow draught boats for service on rivers whose depth does not permit of the employment of craft with a greater draught than a few inches, or at the most a foot. There are many such waterways and rivers, and hitherto traders on them have been unable to reap the advantages of motor propulsion, especially as in most cases only a very low speed is required with a cor-

respondingly large propeller, altogether out of proportion to the available draught of water. One of the special correspondents in Mesopotamia has given an account of a hospital ferry in use on the Tigris, which is fitted with an air propeller and a 50 horse-power semi-Diesel engine, and "makes more noise than a minor battle."

It might be thought that if submerged propellers are unsuitable for slow shallow draught vessels the aerial propeller would be equally inefficient, since it is apparently adapted for propulsion at high speed, and not at such speeds as those required for the vessels referred to, which may be no greater than three or four miles an hour. But from results attained by aerial-propelled tugs and barges it has been proved that this is not the case, and that aerial propellers can be designed efficiently both for relatively heavy low-speed craft and for light high-speed vessels of the skimmer or hydroplane type. In fact, it seems that these two classes of boats are the most suitable for aerial propulsion, and certainly by far the greatest number of examples at present in service are comprised in these categories.

As an instance of the success of aerial propulsion, a 30-foot boat, drawing only 9 inches, in which a 15 horse-power engine is installed driving an aerial propeller of about 8 feet diameter, has been in service for some time, towing some 15 or 20 shallow-draught punts, each loaded with about 2 tons. At the other extreme, there is the type of boat represented by an 18-foot skimmer, which attains a speed of 30 miles an hour, the machinery installation consisting of a 50 horse-power motor driving a two-bladed aerial propeller. These results, which may be taken as typical, appear to be equal to anything that could be attained by the employment of the same power driving a submerged propeller.

ENGINES AND PROPELLERS

All the leading types of motor have been employed for aerial propulsion, including the semi-Diesel, paraffin, and gasoline motors, the last only for high-speed boats. As, in any case, there has to be a chain drive to the propeller, its speed of revolution can be varied within wide limits for maximum efficiency, to suit the craft which has to be propelled. This is a particularly advantageous feature, owing to the diversity of the boats on which aerial propulsion is used, and the speed of rotation of the engine does not have to be seriously taken into account when designing the installation.

It is an almost invariable rule to adopt two-bladed propellers, although there does not seem any reason why three or even four-bladed propellers should not be employed in certain cases, especially where a large blade area is desirable. In one or two instances tractors have been utilized, but this arrangement does not seem to give the best results, besides possessing the disadvantage of inconveniencing those who are on board, owing to the draught of air that is created. The question of danger with a rapidly-revolving propeller also has to be considered; this is minimized, if not entirely avoided, by properly protecting the propeller with an open wire netting.

There is little likelihood that the aerial propeller will ever in any sense replace the submerged type, since in the larger number of cases of the application of the marine motor to the propulsion of boats it does not offer any particular advantages, and indeed possesses some disadvantages. But there are many instances in which the submerged propeller is unsuitable or even impossible, such as in the extremely shallow-draught craft mentioned above, and it is here that a wide field of application for the aerial propeller is opened out.—*Engineering Supplement of the London Times.*

COMPRESSED AIR AT INSPIRATION MINE

The following is from a comprehensive paper describing the entire plant of the Inspiration Consolidated Copper Company, Miami, Arizona, by H. Kenyon Birch, chief engineer of the company, presented at the Arizona meeting of the A. I. M. E., September, 1916.

THE COMPRESSORS

Compressed air is used for two distinct purposes—for underground haulage and for mine drills. For the first 1,000-lb. air is used and 100-lb. for the second. The haulage system is served by two compressors, each having a capacity of 1,125 cu. ft. of free air per min. at 107 r.p.m. These are of the duplex four-stage motor-driven type, the cylinders being cross-compounded, water-jacketed and having inter-coolers between the stages. These compressors have an automatic regulating scheme

whereby, when a predetermined high-pressure point has been reached, the 1,000-lb. discharge line is cut out and the four cylinders are converted into a double-compound compressor discharging directly into the 100-lb. main. Each compressor is driven by a 430-h.p. self-starting synchronous motor.

The low-pressure equipment consists of two 100-lb. compressors having capacities of 3,000 and 7,270 cu. ft. of free air per min. Both compressors are of the parallel two-stage type, all cylinders being water-jacketed with intercoolers between the two stages. The 7,270-ft. machine is equipped throughout with Hoerbiger-Roegler plate valves, which, on account of the very short movement and exceedingly light construction, permit of a very high compression efficiency. The cylinders of this machine are 46 in. and 28-in. by 36-in. stroke. It is driven by a self-starting synchronous motor of 1,150 h.p. The 3,000-ft. machine is driven by a 500-h.p. self-starting synchronous motor at 107 r.p.m.

Two 100-kw. 125-volt motor-generator exciter sets arranged to operate in parallel serve as exciters to the compressor motors. Cooling water for the jackets and intercoolers is obtained from a circulating system consisting of a duplicate installation of 750-gal. triplex pumps and a spray cooling pond.

The compressors and hoisting equipment are housed in a spacious and well-lighted building which has a 25-ton electric crane running its entire length and connecting at one end with a well into which railroad cars can be run and unloaded. A 22-panel remote-control switchboard, together with the low-tension (2,200-volt) bus equipment, occupies a room along one side of the building, the high-tension transformer station being outside near one end of the building. Only two attendants per shift are required, one being an oiler. Without the automatic features for hoisting ore and the elevator for handling men, at least four would be required.

COMPRESSED AIR LOCOMOTIVES

Two types of motive power for underground haulage were considered—electric and compressed air. On account of less danger to life due to the elimination of bare conductors, the compressed-air locomotives was chosen rather than the electric. The difference in the efficiency of the two systems is probably a very small percentage of the total cost.

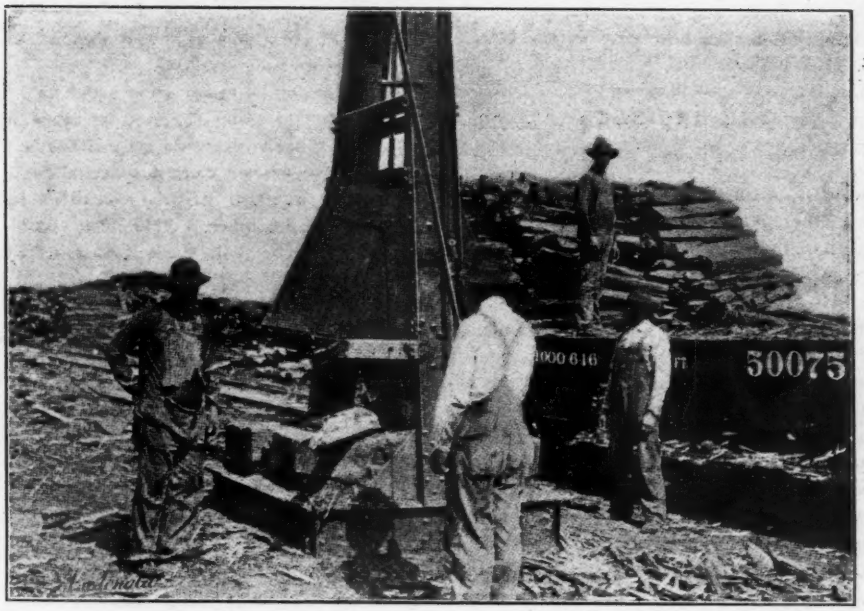
The locomotives are of the two-stage, four-wheeled type and have a weight on the drivers of 10 tons. The initial cylinder air-pressure is 250 lb. and the charging pressure 800 lb. per sq. in. The haulage capacity per charge was estimated at 500 ton-miles. The locomotives haul 25 cars, each of five tons capacity on a 30-in. gage track over a 0.4% grade in favor of the load, and will negotiate a curve of 38-ft. radius.

STEAM FOR MELTING SOFT METAL

In its manufacturing processes the Amalgamated Machinery Corporation of Chicago uses large quantities of type metal, an alloy of lead and antimony, for setting bearings and the like in cored castings. The alloy has a melting-point of 475° F., and it is essential that it be poured at a temperature not exceeding 550° F. Ordinary gas-heating melting furnaces such as are in common use for this kind of work necessitate the constant vigilance of an attendant using a thermometer in order to prevent overheating of the metal bath. It was thought that by means of a coil containing steam at sufficiently high pressure, the latter being kept constant automatically, the metal bath could be kept in proper condition, ready to be drawn from without an attendant. The pressure at which saturated steam has a temperature of 550° F., is 1050 pounds per square inch. It was found, however, that to insure transfer of heat, desirable to employ a temperature of 600° F., corresponding to a pressure of 1575 pounds per square inch. An apparatus designed by Winslow Brothers, of Chicago, consisting of a receptacle carrying a steam coil for heating a cast-iron crucible connected to a high-pressure boiler of special design, heated by gas, fulfilled the requirements. The details of the apparatus have worked reliably in practical operation, and it is possible to keep the metal in a melted condition at the desired temperature, ready for instant use, without more attention than a casual glance at the pressure gauge.—*American Machinist.*

OLD RAILROAD TIES FOR KINDLING WOOD

It has long been a question, without satisfactory solution, what to do with old railroad ties as they are successively replaced by new ones. A quite common practice has been to assemble them in piles alongside the track and set fire to them, but the wastefulness of the



BREAKING UP RAILROAD TIES.

practice has been a standing reproach. The wood is thoroughly seasoned and makes excellent kindling wood, so that it did not look well for a railroad to be buying kindling wood for its locomotives with this available supply costing money for its destruction. It is estimated that on the Burlington lines west of the Missouri above a million and a quarter of ties are thrown out every year.

The half tone here reproduced from the *Scientific American* shows a pneumatic tie splitting machine busily employed on the above lines. The device works on the principle of a steam hammer but uses compressed air for motive power, breaking up each tie into four pieces. A heavy weight to which is attached a knife resembling a huge spike is raised by compressed air to a height of 6 or 8 feet and allowed to drop, at one blow splitting the tie into two pieces lengthwise. These are then turned crosswise and another drop breaks or cuts them in two. The ties, having been thus cut into quarters, are loaded into cars for shipment to different points on the division as the wood is called for.

The tie splitting camps are isolated from the main railroad shops for fire protection. Piles of ties waiting to be cut up are several blocks long. The ties are transported to the tie splitter over a little stub line of railroad a couple of blocks long. Cars are placed on another track by the side of the tie splitting machine and the wood is loaded directly onto them as the ties are cut up. Old box cars that formerly were burned to get at the metal also find their way to the wood yard and are cut up for kindling wood.

WHERE WAGES HAVEN'T GONE UP

Surprise might be expressed that miners' wages in California to-day are nearly the same as in 1869. We are accustomed to think that the wages of all workmen in the United States have risen steadily since a generation ago, partly on account of the increased cost of living. This is exactly the reason why wages on the Mother Lode have not increased, because the cost of living there is lower than in 1869. In those early days the high freight-rates and the lack of agriculture in California made for high prices in most of the necessities of life. To-day a miner in California can, and does, support a family in comparative plenty on the wages that in 1869 only sufficed to keep a single man in good health and spirits according to the generous standards of those bluff times. The cost of living in California has increased recently by reason of the widening demand for luxuries, but a miner on the Mother Lode lives most comfortably in the snug mining towns, reinforcing his wage by the produce from his garden and by the mod-

ern facilities for economizing in the home.—P. B. McDonald.

THE ENGINEER

BY DR. FRANK CRANE

The man of the future will be the engineer. He is the man who can Do things; and is better than the man who Owns things.

The Millionaire is a temporary, passing, makeshift product of civilization. He is merely holding things together until the people get sense enough to do their own owning.

Some day little boys will read that the world once had millionaires and huge private wealth units, just as they will one day read and wonder that men once had kings.

But the official who will forever be indispensable is the engineer.

The time will come when the President of the United States will be chosen as the man who has the greatest talent and skill in organizing public works. There will be no more politics in his selection than there is now in choosing the master mechanic of a railway or factory.

When a nation goes to war nowadays, that is, when it becomes necessary to exert its supreme collective strength, nobody dreams of electing the most popular politician or the cleverest speechmaker to lead the armies. It is the man who can get the last ounce of efficiency out of men and metal that is wanted.

Some day the nation will realize that it is continually in a crisis, and that in peace as in war we need the highest order of efficiency and organization.

We need the Engineer to arrange the transportation of people and goods from place to place, without waste, without competition, without graft, looking only to the public good.

We need the Engineer to get meat, bread, and milk from farm to citizen, without the present inefficient tangle of trusts and middlemen working at cross purposes.

We need the Engineer to turn the profit of public enterprise toward building good roads and bridges, instead of enriching a few shrewd manipulators.

We need the Engineer to manage a city as economically and smoothly as if it were a manufacturing plant.

We need the Engineer to organize the farmers so that all can work together for each and their products be marketed without being preyed upon at every step of the way from farm to household.

Wealth can be taken away from us. But the power to Do things cannot be taken away.

The Millionaires could go and not be missed. The Engineers we cannot spare.

"What availeth all thy wealth" said the ancient philosopher. "He that hath better iron than thee will come and take away all thy gold."—*Globe*, N. Y.

THE SAPPERS AND MINERS

BY BERTON BRALEY

When you read of a trench of soldiers
That's blown in the air a mile,
While the guns that flashed are broke and smashed
And the earth torn up in style,
You can write it down in your notebook
As soon as the dust cloud clears
That the canny chaps who ran the saps
Were the Army Engineers;
The human moles who live in holes
Where nary sun appears,
The grimy, gritty, far-from-pretty
Army Engineers.

They are miners who come from coal mines
To mine in the earth—for Men!
They are trolls and gnomes who make their homes
In a subterranean den.
So they tunnel beneath the foeman
Till they've got the business right
Then they spread the foe for a mile or so
With charges of alamite.
They do their work in muck and murk
With neither shots nor cheers,
These sturdy, plucky, mired and mucky
Army Engineers!

They must dig their drifts in silence
And chop their way by hand,
And the dirt they pack on each sapper's back
And scatter it on the land;
For they mustn't leave any traces
Which the enemy sees or hears,
Or they'll get a lift from a counter-drift,
That's bad for the Engineers!
Yes, now and then they lose their men
Amid war's hopes and fears,
They know the hell of war full well
The Army Engineers,
The muddy, bloody, sweaty, loyal
Army Engineers. —*Coal Age.*

COMPRESSED AIR MAGAZINE

EVERYTHING PNEUMATIC

Established 1896

W. L. SAUNDERS, - - - - Editor
FRANK RICHARDS, - - Managing Editor
CHAS. A. HIRSCHBERG, - Business Manager
W. C. LAROS, - - - Circulation Manager

PUBLISHED MONTHLY BY THE

Compressed Air Magazine Company
Easton, Pa.

New York Office—11 Broadway.
London Office—165 Queen Victoria Street.

Subscription, including postage, United States and Mexico, $1.00 a year. Canada and abroad, $1.50 a year. Single copies, 10 cents.
Those who fail to receive papers promptly will please notify us at once.
Advertising rates furnished on application.

We invite correspondence from engineers, contractors, inventors and others interested in compressed air.

Entered as second-class matter at the Easton, Pa., Post Office.

Vol. XXI. NOVEMBER, 1916. No. 11

CONTENTS

Mining Thin Coal Beds 8163
Don't Use Compressed Air 8164
Pneumatic Tamping Reduces Track Gangs 8165
Contractors Portable Air Compressors... 8168
Tunneling Heroes of the War..... 8170
Wind Cave 8171
Principles of Refrigerating Systems.... 8172
Compressed Air for Perpetual Motion.. 8174
Pneumatic System for Burning Powdered Coal 8175
To Make Air Tight Brass Castings..... 8175
Roosevelt Drainage Tunnel Record..... 8176
New Model Little Tugger Hoist..... 8177
Diving Helmet Always at Hand..... 8177
Air Pressure Mine Sprinkling Car..... 8179
Air Propellers for Boats 8180
Compressed Air at Inspiration Mine..... 8181
Steam for Melting Soft Metal..... 8182
Old Railroad Ties for Kindling Wood... 8182
Where Wages Haven't Gone Up..... 8183
The Engineer 8184
The Sappers and Miners..... 8184
Cooling-Water for Air Compressors.... 8185
Drying Air for Sand Blast..... 8186
Handbook of Casinghead Gas 8187
Fire Fighting in Metal Mines 8187
Signals for Field Engineers..... 8189
Notes 8190
Patents 8191

COOLING-WATER FOR WATER JACKETS AND INTERCOOLERS

The following article, which we reprint from a recent issue of *Factory*, requires some explanation before it can be read understandingly. Water for cooling purposes is used for two different services in connection with two-stage air compressors, the one being for the water jackets of the air cylinders and the other for the intercoolers, only the former of these being mentioned in the article. While the water jackets are very necessary for all continuously running compressors, they really do very little cooling of the air during compression their principal use being for the purpose of keeping the body of the cylinder as cool as possible in favor of proper lubrication, etc. As a consequence a small quantity of water circulating through the water jackets is generally sufficient and the average flow or discharge from the water jackets will generally be found to be only slightly warmed.

The function of the aftercooler, however, is very different. This is expected to cool the entire body of air passing through the compressor, taking it in at the high temperature resulting from the first stage of the compression and cooling it to a temperature as near as possible to normal before it passes into the high pressure cylinder for the final compression. In the intercooler, therefore, the temperature of the cooling water rises rapidly and an active circulation of the water must be maintained, and if the same water is to be used over and over the problem of cooling it is an important one. It is the cooling water required for the intercoolers rather than for the water jackets which is principally dealt with in the article which follows:

During a recent campaign for reduced water consumption in a large foundry, two high-pressure air compressors invited particular attention. These machines were of the two-stage, two-cylinder type, and the intake pipe of the water jacket on each cylinder was connected directly to the city water main, while the discharge pipe emptied into the sewer. In other words, water for cooling the cylinder was used but once for this purpose. The daily water consumption of these machines was about six hundred cubic feet.

It was proposed to install a thermosyphon cooling system, so that the same water might be used repeatedly without waste. For this

purpose a discarded steam boiler of seventeen hundred gallons' capacity was utilized. The intake pipe of the water jacket was connected to the bottom blow-off of the boiler and the water jacket discharge pipe into the top of the boiler. The boiler dampers were opened wide to facilitate complete circulation of air through the flues.

When this home-made cooling system was put into use the temperature of the water before starting the compressor was sixty degrees Fahrenheit, and at the end of the day a temperature reading showed one hundred and fifty degrees Fahrenheit.

In operating a compressor of this type, the low pressure cylinder receives its air from the atmosphere, compresses it to a pressure of forty-five pounds per square inch, and then delivers it to the high-pressure cylinder, where the pressure is raised to about ninety pounds per square inch.

It is desirable that the temperature of air taken into the high pressure cylinder be as near the temperature of the atmospheric air as possible, in order that maximum efficiency in power consumption may be obtained. It is estimated that each rise of eleven degrees Fahrenheit in temperature of air delivered to the high-pressure cylinder means an increase of one per cent. in the power required to compress a given quantity of air.

Under the previous plan with the Cooling water running direct to the sewer, it was possible to deliver air to the high-pressure cylinder at a temperature twenty degrees Fahrenheit higher than that of the atmosphere, while with the newly installed thermo-syphon system the temperature was at least seventy degrees Fahrenheit higher.

This indicated that the saving in water consumption was being effected at an expense of six to ten per cent. increase in power consumption, which was decidedly disadvantageous.

Water supplied to the barrels in the foundry was, at that time, obtained from a gravity water tank, which, in turn, was connected to city water main by means of a float valve. This arrangement of piping was changed so that the city water main was connected direct to the intake pipe of the air compressor water jacket, while the gravity water tank for supplying the water barrels received its supply from an outlet pipe located sixteen inches below the top of the boiler used in the water-cooling system.

As a result of this change, the thermo-syphon was placed under the city water pressure, and as the warm water was drawn from the top of the boiler for foundry use, a fresh, cold supply was injected into the cooling system from the city main.

After these changes were made no more waste occurred in the use of water. At the same time the total rise in temperature of the cooling water after a day's operation was reduced to fifteen degrees Fahrenheit.

This simple arrangement made it possible to save six hundred cubic feet of water a day without materially increased power consumption at the air compressor.—B. J. S.

DRYING AIR FOR SAND BLAST

The following question and answer we reproduce from the page of an esteemed and generally reliable engineering journal. The instructions given can scarcely be regarded as satisfactory, and are hardly in accord with discussions of the same topic which have appeared in preceding issues of the same publication.

"Air used for etching electric light globes is delivered into a tank in the basement of the building at a pressure of from 20 to 25 lb. From this tank it is carried to a smaller tank on the fourth floor and thence through a 2-in. header feeding 4 1½-in. sand blast lines. It is of great importance that no moisture reach these machines and I wish, therefore, that you would kindly tell me how to dry this air.

P. McN.

"A. In small installations there is little that can be done economically to secure dry air at the nozzle other than by the installation of tanks, such as you have in your line. A precaution, however, is to be sure that the discharge outlet from these tanks is taken from the top so that none of the moisture which may collect near the bottom of the tank will be carried on to the air jet. These tanks act as separators and should be drained occasionally, as circumstances require. In some large installations it is customary to refrigerate the air before it enters the air compressor, thus reducing the amount of moisture to a minimum, so that after the air has expanded at the outlet nozzle no moisture will be present. Another provision which also tends to reduce

moisture and at the same time increase the power available in compressed air, is that of installing re-heaters. These raise the temperature of the air just before it is used, so that, during expansion in the tool, the temperature does not reach much below that of the atmosphere and with the precaution mentioned above of taking the outlet pipes from the top of the storage tanks, this arrangement will, in most cases, insure dry air."

As to the general problem of getting dry compressed air, there are two or three things to be remembered which should render the solution comparatively simple. In the first place there is no such thing as dry air, and at the best we can only get the air comparatively dry, or dry enough to satisfy the requirements in specific cases. The capacity of air for carrying water in the invisible or strictly vaporous condition varies with both its pressure and its temperature, increase of pressure reducing the capacity while increase of temperature increases also this capacity very rapidly. In the act of compression, while the moisture capacity of the air is reduced by the increase of pressure that capacity is increased much more rapidly by the increase of temperature which results from the compressing so that the air as it leaves the compressor at its highest temperature is dry air, although the actual moisture in the air has not been changed in any way. If this hot air goes into a receiver or tank near the compressor and passes through it without being cooled the moisture will be still in the air and will be carried along with it, and of course it will make no difference whether the pipe leading out of the receiver is at the top or at the side. If the air is conveyed through a long pipe it will cool quite rapidly, or if it has not far to go it may be cooled by passing through an aftercooler. In either case when we have the air *at its highest pressure and its lowest temperature* the same air which before was dry will now be wet air, and much of the water, enough of the water to satisfy the purpose, may generally be drained out of it. If the air at high pressure and low temperature flows along horizontal pipes the water will accumulate in low places or pockets along the line, and must be drawn off, or if the air has only a short run it may, after leaving the aftercooler, be passed through a steam separator or similar device and the water be got rid of in that way. The cooling of the air while at full pressure is the most necessary condition for draining the air, but the mere cooling of the air, as spoken of above, before it enters the compressor of course does not take any water out of it. The water that is dropped by the cooled air as it flows along, as mentioned a few lines above must be drawn off or it will be mechanically blown along by the air and make more serious trouble than if it had not been separated at all.

NEW BOOK

Handbook of Casinghead Gas, by Henry P. Westcott, Metric Metal Works, Erie, Pa., 285 pages 7¾ by 5-in., 55 illustrations, 100 tables, price $2.00.

Casinghead gas had been the familiar accompaniment of the mineral oil industry from the beginning, but its importance and value were not at first recognized. It is estimated, however, that in 1915 thirty billion (30,000,000,000) cubic feet of casinghead gas was used in making gasoline by the compression process alone. This book gives in compact form the most important information upon the general topic and then the details of gas manipulation and utilization in most practical form. It treats of the testing of casinghead gas wells, analyzing apparatus for gasoline content, Orsot apparatus for determining oxygen in gas, the absorption process, construction of plant, pipe lines, carbon block from residue gas, etc., and then the formulas and tables for handy use by those in any way in touch with the industry.

DIFFICULTIES IN FIRE-FIGHTING WORK IN METAL MINES

In some respects fire-fighting and recovery work is much more difficult in metal mines than in level coal mines. Although fire damp or inflammable gas is frequently an additional menace in coal-mine fire recovery operations, this is often more than overbalanced in metal mines by the fact that operations may be carried on simultaneously on a number of different levels, some of the deep metal workings being nearly as far from the surface by a vertical or inclined measurement as some coal workings are by a horizontal measurement. So metal-mine rescue and recovery operations often necessitate continual descending or climbing on the part of the rescue crews. This is a serious and dangerous handicap, the effect of

which should not be overlooked or underrated. The men generally feel more seriously the burden of the weight of the rescue apparatus and are hampered to greater extent by its limitations than they commonly are in coal-mining operations except in steep dipping coal beds.

The general mine temperature and humidity encountered are frequently much higher in metal mines, and the men are weakened by these conditions. Also there is nearly always the danger not encountered in most coal mines of some member of the rescue crew falling into an uncovered chute while working in the smoke. Ladderways are frequently constructed with openings just large enough to admit a man. Rescue crews with apparatus have difficulty in passing through these openings, and there is danger of damaging the apparatus in attempting to travel such ladderways; hence the need in metal mine operations of better planning, which will be best brought to attention by recovery drilling.

The above is a sample extract from a mine rescue handbook just issued by the Bureau of Mines. The full title is: "Rescue and Recovery Operations in Mines after Fires and Explosions." The authors are James W. Paul and H. M. Wolfin, the former dealing with coal mines and the latter with metal mines. There is less than 100 pages of actual text, but these are filled with practical information and suggestion. The size of the publication 4½ by 6-in., just one-half the usual size of the Bureau pamphlets, makes it handy for the pocket. It is distributed freely upon application at first, the later standard price being 10 cents for paper covers, and 25 cents in red buckram.

HOW ONE THING LEADS TO ANOTHER

That labor-saving machines economize work is unquestioned, but that a further advantage ensues from providing more work is not so well understood. Putting a mechanical drill-sharpener in a mine's blacksmith-shop immediately effects reduction in the cost of sharpening the drills. But, as pointed out by the *Compressed Air Magazine*, the consequent ease and quickness with which drills can be sharpened leads to more frequent sharpening of them; that is, when a bit becomes worn, the miner does not waste time trying to work with a dull tool, but changes to a sharp bit; he knows that dull bits can be sharpened easily and cheaply. This procedure is typical. The speeding of one link in a chain of connected operations is likely to spur others, and one improvement leads to another. The principle that the saving of work makes more work sounds paradoxical, but is quite as true as the axiom that "money makes money, and the money that money makes makes more money." —P. B. McDonald in *Mining and Scientific Press.*

OZONE IN WAR SURGERY

Among the branches of surgery to which the exigencies of the European war have acted as a sharp stimulus may be mentioned the treatment of infected wounds. The proportion of patients who reach the military hospitals with their injuries thus aggravated is so large as to have given great importance to the subject of antiseptics, since obviously the perfect aseptic treatment which most cases can enjoy in ordinary hospitals in time of peace is out of the question for the majority of battle wounds.

Many antiseptics, unfortunately, though excellent germicides, are so toxic that there is danger of their harming the vitality of the tissues surrounding the wound. For this reason hydrogen peroxide is admirable, since it is germicidal without being in any way injurious to healthy cells. However, it is not adequate in those cases, so common in warfare, where there is a serious amount of suppuration. It is almost instantly decomposed, not only by pus, but by blood and most of the other liquids of the body tissues, so that the amount of mascent oxygen released is insufficient for the requirements of a serious wound.

The search for an oxidizing agent not open to this objection led to the trial of ozone, either dissolved in water and used in copious irrigations, or in a gaseous state, mixed with ordinary diatomic oxygen. The latter style of treatment is especially advantageous in the case of wounds which are slow in forming a scab, since the most spacious bandages often have a tendency to rub off the fresh scab tissue. This difficulty is avoided in the process in question by surrounding the wound with a hermetically sealed shell, into which can be passed the gaseous current. This method possesses the extraordinary advantage of leaving

the wound open to the beneficial action of the solar radiations as well. Then, too, the total exclusion of the ordinary air from the tissue under treatment makes impossible the formation of nitrogen compounds, which might prove decidedly irritant.

The other mode of application, through the use of ozonized water, has been found particularly satisfactory for large shattered wounds, where the tissues have been directly invaded by septic substances. The irrigation processes may be indefinitely prolonged without bad effect, thus making possible a methodical and efficacious cleansing of all infected tissues, whether they be deep or superficial. *Scientific American.*

SIGNAL CODE FOR FIELD ENGINEERS

The signal code embodied in the accompanying half tone, presented in a recent issue of *Western Engineering*, San Francisco, by Mr. W. R. Sherman, of Newman, California, may require some effort to memorize and some practice to use it without hesitation, but when once mastered it should be an acquisition of practical value.

In the starting position both hands rest on the breast, 11, and after each signal return to the same position. The different signals, corresponding to the illustrations, are 1, 2, 3, 4, 5, 6, 7, 8, 9, and 0, and are self explanatory. For the alphabet the numbers corresponding to the alphabetic positions of the letters are given; that is A-1, T-20, Z-26, etc. The letters are separated by a dip and the words by a rise, both of which are shown. The dip and rise also indicate that letters, and not numbers are being given. The signals are shown in the accompanying illustration, commencing with 1 at the left, the positions for start, rise, and dip being on the right. Convenient practice may be had by two persons standing at opposite ends of a room and sending any copy, such as columns of figures, that may be at hand.

SIGNALS FOR FIELD ENGINEERS.

PNEUMATIC CONCRETE PRACTICE AT TWIN PEAKS TUNNEL

Twin Peaks Tunnel, a costly municipal improvement of San Francisco, forming a new highway on the line of Market Street, is to have a total length of nearly 12,000 ft. and about 8,000 ft. has been driven from the two

portals. In the progress of the work various improvements have successively developed. In *Engineering News* we have a sketch of the operation of conveying and placing the concrete lining.

The concrete is conveyed and placed by the pneumatic process. Two plants have been installed, one near each portal. Specifications for concrete call for a consistency of 1 part cement to 2¼ of sand, with sufficient rock added so that the mortar fills the voids—approximately 5 parts. With every 100 lb. dry cement 8 lb. hydrated lime is mixed for waterproofing. From the mixers on the surface, charges are dropped through a measuring hopper into the air chamber, whence it is forced into the forms through a pipe with spiral projections to give the mixture a rotary motion. At the west end, concrete has been conveyed pneumatically 2,500 ft. up a 1.15% grade, and it is anticipated that a distance of 3,000 ft. will be served up the 3% grade from the east mixing plant. The sequence of the concrete operations follows: (1) 100 ft. of footing poured on each side; (2) second and third days following, footing forms stripped, tracks laid for form tower and steel forms set; (3) 40 ft. of side walls and ceiling slab started the third day after initial pour; (4) while section of walls and ceiling are being poured, the remaining wall and ceiling forms are set. excavation finished and next forms set.

A CONTINUOUS GAS LIGHTER

According to a report at the annual meeting of the Illuminating Society, the most striking innovation of the year has been the development of a gas glower for the ignition of gas lamps. This consists of a bundle, cylindrical in form, about one-quarter of an inch in diameter and of about the same length, made up of several thousand filaments made from rare earth material similar to that used in the incandescent mantles. Gas is delivered to the center of the mass and combustion takes place throughout but with greater intensity at the top. The device consumes approximately one twenty-fifth of a cu. ft. per hour or 350 cu. ft. per year, which is about one-half that consumed by the ordinary pilot flame of a residential burner.

FRESH AIR FOR SUBMARINES

A new process for supplying pure air to submarines has been discovered. The inventor, William G. Bond, of Wilmington, Del., recently demonstrated the use of his apparatus by remaining in a test chamber three feet by four feet by six feet for seven hours with only the air furnished by his device. The air is purified by a chemical reaction between carbon dioxide and certain solutions exposed to the atmosphere of the chamber. The carbon is absorbed and the oxygen liberated.

The test room used was entirely surrounded by water. Mr. Bond entered the tank, clad in a bathing suit and supplied with reading matter, food, air-testing apparatus and the chemicals. He kept in communication with the observers on the outside by means of a telephone. At a stated time, the supply of oxygen furnished by the apparatus was cut off and he remained for three-quarters of an hour longer. Though the air had been perfectly wholesome for seven hours, at the end of the forty-five minutes the inventor emerged breathing very heavily.

The value of this discovery to the submarine is yet undetermined. Its advantages are the simplicity of operation and the low cost of installation and maintenance. Let it be said, however, that any practicable method for ventilation of the submarine will be welcomed.—*Popular Science Monthly.*

NOTES

Tin now ranks first among Bolivia's mineral exports, having displaced silver in 1915. The exports of tin last year were 36,492 tons, valued at $16,300,000, copper exports ranking second at 23,812 tons, valued at $5,200,000.

In its ability to produce war orders completely within its own plant, the Nova Scotia Steel & Coal Company occupies a unique position. Out of the many thousands of cars built in America, in the past year for the Russian Government, that company, with its order for 2,000 cars, is probably the only builder which mined the ore, fabricated the material and delivered the cars in Asiatic Russia without calling in the aid of any other concern, either for raw material, the manufacturing or the transportation.

Raw gasoline extracted from natural gas and sold in 1915 amounted to 65,364,665 gal., a gain of 53 per cent. over the quantity marketed in 1914. The number of plants for manufacturing gasoline from natural gas increased from 386 at the beginning of 1915 to 414 at the end of the year.

More natural gas was used in the United States in 1915 than in any other year, according to statistics completed under the supervision of the U. S. Geological Survey. The quantity was 628,578,842,000 cu. ft., which exceeds by 6 per cent. the record established in 1914.

T. A. Willson & Co., Inc., Reading, Pa., has been awarded a large Government contract of an unusual character. It is stated to be the first official order ever issued for eye protection equipment for the exclusive use of the country's armed forces. The company's Albex eye protector has been adopted and standardized by the War Department and will soon be a part of the regular equipment of 50,000 troops. The company had previously received an order for about 25,000 goggles for shipment to El Paso and other Southern points. Within a few months about 75,000 enlisted men will be equipped with Willson eye protectors.

What is believed to be the largest natural draft cooling tower so far built has recently been completed at the Anderson, Ind., plant of the American Steel & Wire Co. This tower is of the Wheeler-Balcke type, built by the Wheeler Condenser & Engineering Co., of Carteret, N. J. The tower is approximately 150 long, 50 ft wide and 75 ft. high, and has a yellow pine frame with cypress sheathing and filling. The tower has two chimneys which rise above the cooling stacks and create the air circulation by natural draft. The capacity of the tower is 7300 gals. a minute, cooled from 115 to 85°.

An international airship corporation in Berlin wishes, after the war, to establish an aerial post service (and if this proves a success, a passenger line) between Berlin and Constantinople. A capital of $6,000,000 is estimated as necessary. Its plan is to have the route extend from Berlin to Carlsbad, continuing to Vienna via Budweis, from there to Budapest, and thence on to Constantinople over Sofia. Between these larger cities are to be numerous landing stations, the cities chosen for landings to subscribe for shares.

Finely powdered aluminum forms a part of two of the most destructive explosives known, one of which, ammonal, is a mixture of five to eight parts of ammonium nitrate with one part of aluminum powder and is used to charge shells. It is one of the few explosives which presumably can never be used as a propellant, as its action is so sudden and the force so tremendous that no gun would be able to stand it.

LATEST U. S. PATENTS

Full specifications and drawings of any patent may be obtained by sending five cents (not stamps) to the Commissioner of Patents, Washington, D. C.

SEPTEMBER 5

1,196,807. AUTOMOBILE - HORN. WILLARD PENNOCK, Minerva, Ohio.

1,196,849. VACUUM-TUNNEL BOAT CONSTRUCTION. CARL H. FOWLER, New York, N. Y.

1,197,049. AIR VALVE. A. C. MEIXELL, Atlanta, Ga.

1,197,115. SUBMARINE LIFE-PRESERVER. GEORGE EDWARD FELL and GERTRUDE AXTELL FELL, Buffalo, N. Y.

1. A life-saving apparatus, comprising a face-mask, a float containing an air supply-chamber and an air inlet arranged to extend above the surface of the water, a flexible air conduit connecting said mask with said air chamber, a righting weight, and flexible means connecting the weight with the bottom of the float.

1,197,144. AIR-CIRCULATING DEVICE. MOSBY MONTAGUE, Christiansburg, Va.

1,197,217. OIL-BURNER. JOHN E. LIMBACHER, St. Marys, Ohio.

1,197,232. PULMOTOR. JURIAH HARRIS PIERPONT, Pensacola, Fla.

1,197,293. GRAIN-SAVER FOR THRESHING-MACHINES. HOMER F. HUTTON, Jeffers, Mont.

1,197,302. PNEUMATIC CALLIOPE. JOSEPH E. ORI, Bloomfield, N. J.

1,197,371. ENGINE-STARTING MEANS. HERBERT T. HERR, Pittsburgh, Pa.

2. In a device for starting motors, means for introducing air into the cylinder of a motor, a speed governor, and fluid actuated means controlled by the governor for rendering the first named means effective to introduce air into the cylinder and movable out of operative position after the motor has started.

1,197,401. HYDRAULIC PUMP. JOSEPH RITTER, Orizaba, Mexico.

1. In an apparatus of the class described, a distributing tank, a compressor tank adapted to be filled with liquid from the distributing tank under a predetermined hydrostatic head, a siphon from the compressor tank for emptying the same at a rate exceeding the supply to the distributing tank, the hydrostatic head of the shorter arm of said siphon being less than the hydrostatic head under which the compressor tank is filled, a charge-receiving, closed tank positioned above the compressor tank, a conduit for supplying liquid to said tank, the hydro-

static head of said conduit exceeding that of the shorter arm of the siphon, a conduit for transmitting air from the compressor tank to the charge-receiving tank, and a liquid outlet from the charge receiving tank to a height exceeding the hydrostatic head of the shorter arm of the siphon as many times as the volume of the compressor tank exceeds that of the charge-receiving tank.

1,197,410. AIR-PUMP FOR OIL-CANS AND OTHER CONTAINERS. ARTHUR JOSEPH TOOL, Murdock, Nebr.

1,197,490. AUTOMATIC AIR-SANDING DEVICE. JAMES HOGAN, Chicago, Ill.

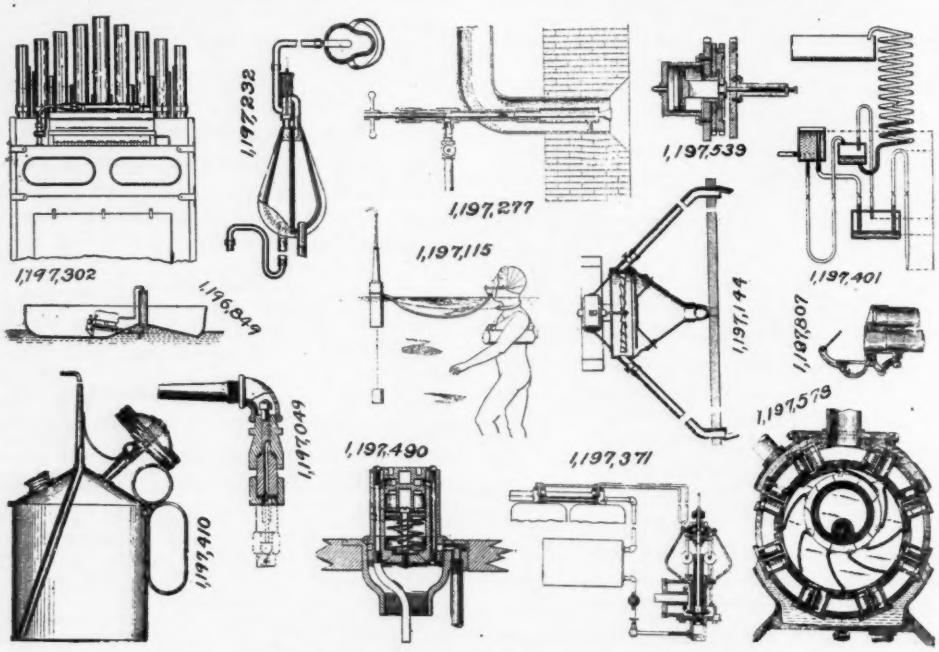
1,197,539. CLUTCH - ACTUATING MEANS FOR AIR-COMPRESSING MECHANISM. AUSBEE PLUMMER, Shaft, Md.

1,197,578-9. ROTARY AIR - COMPRESSOR. HENRY O. JACKSON, Denver, Colo.

inder outside of said submarine to form a communication whereby to permit sea-water to pass into such cylinder, controlling means for controlling the passage through said communication, a holder in said cylinder containing a chemical compound the contact with which by water forms a gas, and gas-receiving means on said submarine connected to said gas generator to be filled by the gas generated thereby when said gas generator is operating, said gas receiving means being spaced from and separate and distinct from said generator so that the water for generating said gas will not enter said gas receiving means.

1,197,653. COMPRESSOR. FRED E. NORTON, Worcester, Mass.

1,197,717. PNEUMATIC MILKING APPARATUS. REUBEN B. DISBROW, St. Paul, Minn.



PNEUMATIC PATENTS SEPTEMBER 5.

SEPTEMBER 12

1,197,596. PNEUMATIC ACTION FOR PIANOS. WILLIAM G. BETZ, Buffalo, N. Y.

1,197,600. OIL - ATOMIZER. JOHN ROBERT BROWN, Vancouver, British Columbia, Canada.

1,197,609. VENTILATOR. THOMAS R. CURTIS, Center City, Tex.

1,197,622. CLASSIFIER. HENRY B. HALLOWELL, Worcester, Mass.

1. In a device of the class described, a casing inclosing a substantially elongated chamber, means for admitting solid matter to be classified to said chamber, means for subjecting the solid matter falling in said chamber to successive blasts of air separated by a period of rest, an air outlet port in the upper portion of said casing, and means for separating the air passing out said port from the particles of solid matter suspended in such air.

1,197,650. MEANS FOR FLOATING OR RAISING FLUID-SUPPORTED OBJECTS. ANTHONY MUSOROFITI, Brooklyn, N. Y.

1. The combination with a submarine, of an emergency floating means comprising a gas generator carried by said submarine and comprising a cylinder, a pipe extending from said cyl-

1,197,771. PUMPING SYSTEM. PHILIP H. SHUE, Denver, Colo.

1. In combination, a series of displacement chambers, and valve-controlled discharge conduits extending from a point adjacent the bottom of each chamber of the series into the next adjoining one, the chambers at opposite ends of the series having respectively a water inlet and a water-outlet and all the chambers of the series being separately connected with a source of fluid-pressure.

1,197,792. AIR-BRAKE SYSTEM. THOMAS HENRY CLAPHAM and JESSE L. MILLER, Pittsburg, Kans.

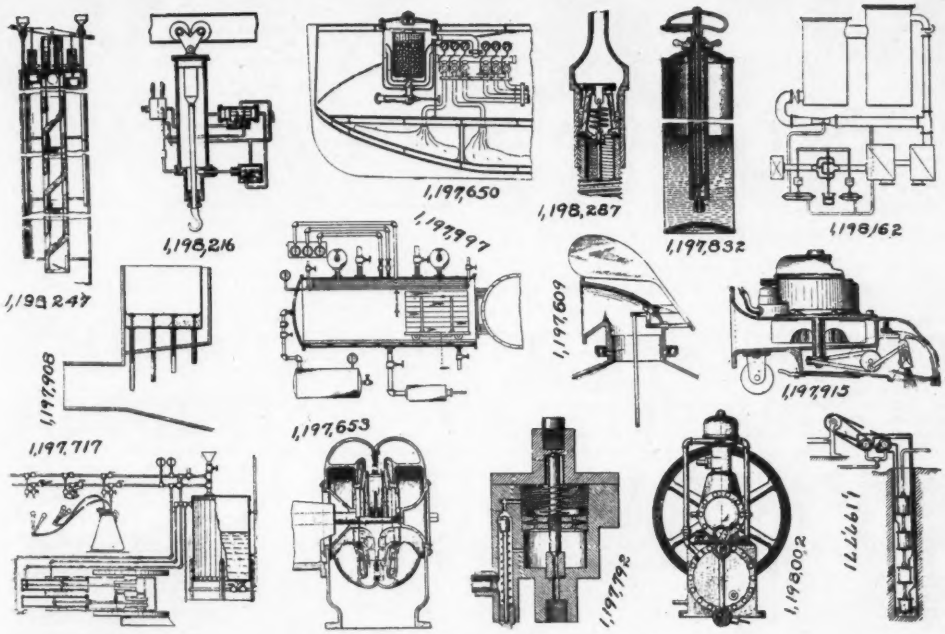
1,197,832. LIQUID-DISTRIBUTER. ARTHUR C. LA MAY, Rochester, N. Y.

1,197,908-9. APPARATUS FOR FEEDING PULVERIZED FUEL. VIRGINIUS Z. CARACRISTI, Albany, N. Y.

1,197,915. VACUUM-CLEANER. CLIFFORD C. DANCE, Denver, Colo.

1,197,997. PROCESS OF TREATING AND PRESERVING WOOD. ANGUS F. BARRY, Kansas City, Mo.

1. The herein described process of treating case-hardened and non-porous wood for the penetration of a preservative without checking of

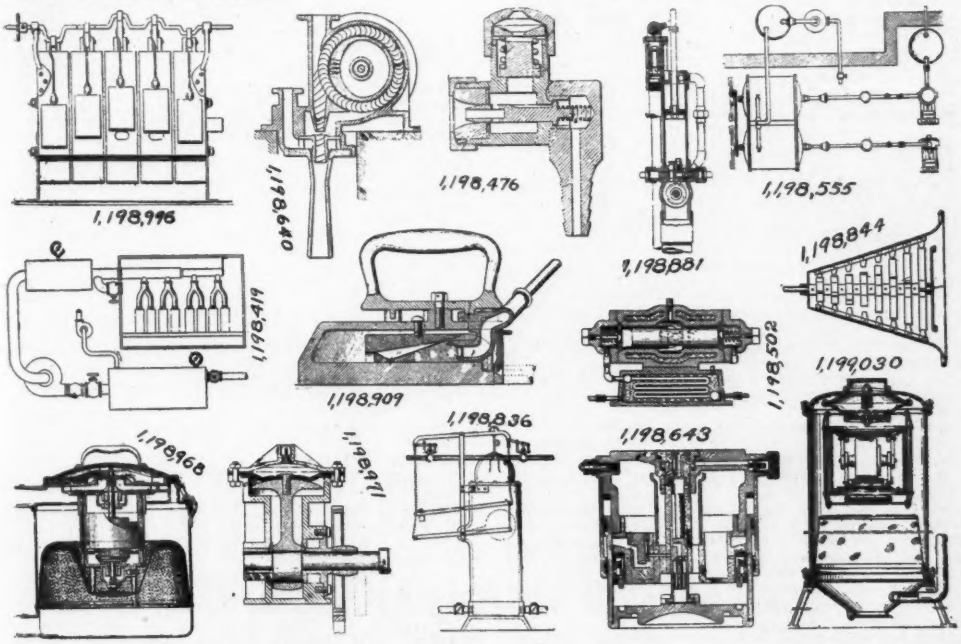


PNEUMATIC PATENTS SEPTEMBER 12.

the wood, which consists in subjecting the wood to a heated vacuum, and supplying a vapor below the boiling point of water for the absorption of the vapor equally by the cellular and case-hardened portions or rings of the wood without breaking the vacuum.

1,198,002. REFRIGERATING - MACHINE. WILLIAM I. BODINE and CHARLES R. SOLOMON, Springfield, Mo.

1,198,125. FLUID-OPERATED TOOL. LOUIS W. GREVE, Cleveland, Ohio.



PNEUMATIC PATENTS SEPTEMBER 19.

1,198,162. REGULATION OF AIR-BLAST IN GAS-GENERATORS. CHARLES H. SMOOT, South Orange, N. J.
1,198,216. FLUID-ACTUATED HOIST. ALBERT JARVIS HANSON, Portland, Me.
1,198,247. AIR-LIFT FLUID-PUMP. PAUL MCCOOMBS, El Paso, Tex.
1,198,266. ROTATION MECHANISM FOR PERCUSSIVE TOOLS. FREDERICK W. PARSONS, Elmira, N. Y.
1,198,287. ATTACHMENT FOR PNEUMATIC-TIRE VALVES. CHARLES G. SPENCER, East Orange, N. J.

SEPTEMBER 19

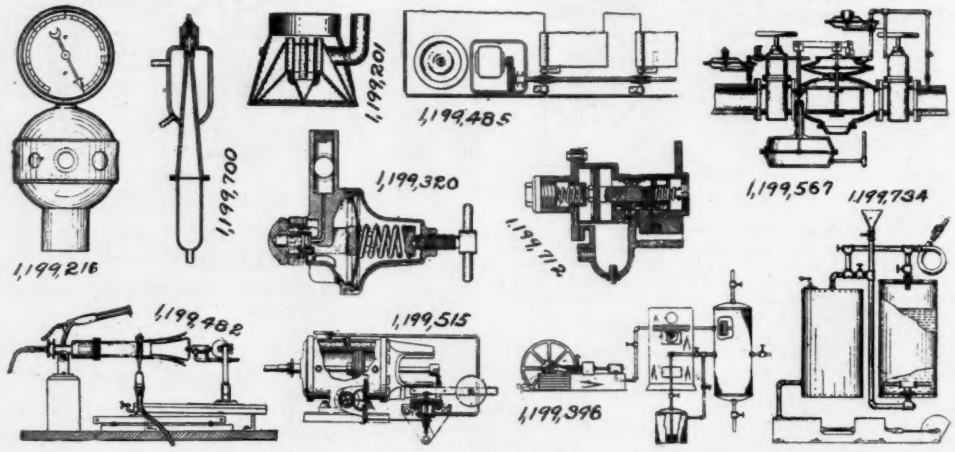
1,198,419. MEANS FOR CONTROLLING DANGEROUS GASES IN SUBMARINES AND OTHER CRAFT. JOHN M. CLARK, Whitestone, N. Y.
1,198,476. PRESSURE-REGULATOR. JAMES H. PEARSON, Bloomfield, Ind.
1,198,502. COMPRESSOR FOR REFRIGERATING SYSTEMS. WILLIAM WISHART and JOHN O. WISHART, Springfield, Ill.
1,198,555. GAS-MIXING SYSTEM. WILLIAM WALLACE KEMP and WILLIAM H. VAN HORN, Baltimore, Md.
1,198,996. PNEUMATIC MOTOR. THEODORE P. BROWN, Worcester, Mass.
1,199,030. PNEUMATIC PUMPING APPARATUS. HOWARD SMALL, Atlantic City, N. J.

SEPTEMBER 26

1,199,201. PNEUMATIC, OR FLUID, CLEANING DEVICE. JOHN EDGAR MOTE, Indianapolis, and LEWIS C. KING, Richmond, Ind.
1,199,216. VACUUM-GAGE. IRA H. SPENCER, West Hartford, Conn.
1,199,320. PRESSURE-REGULATOR VALVE. SCOTT H. TOLMAN, Boston, Mass.
1,199,396. PROCESS OF TREATING AIR. DELBERT E. LIVINGSTON, Kansas City, Kans.

1. The process of treating atmospheric air which consists in heating the air to be treated, to a high temperature, and raising its inherent pressure, then delivering the air thus heated and without material loss of pressure into a stratifying container, and then drawing off from a high, an intermediate and a low level of said stratifying container, separate portions of the resultant contents thereof.

1,199,482-3-4. APPARATUS FOR THE MANUFACTURE OF DOUBLE-WALLED VACUUM-RECEPTACLES. OSCAR MOBERG and EDWARD HOOGE, New Britain, Conn.



PNEUMATIC PATENTS SEPTEMBER 26.

1,198,640. AIR - PUMP. MAURICE LEBLANC, Paris, France.
1,198,643. HYDRO - PNUEMATIC DEVICE. RICHARD LIEBAU, New Haven, Conn.
1,198,777. AIR-BLAST REGULATOR FOR THRESHING-MACHINES. ANTON SCHMITT, Dubuque, Iowa.
1,198,795. ACETYLENE CUTTING AND WELDING TORCH. WALTER W. VON TODENWARTH, Rahway, N. J.
1,198,836. FLUID-PRESSURE PUMP. EUGENE GOILEAU, Montreal, Quebec, Canada.
1,198,844. ACOUSTIC APPARATUS. ELLSWORTH A. HAWTHORNE, Bridgeport, Conn.
1,198,880. ROTARY VACUUM - FILTER. EMANUEL WAGNER, New York, N. Y.
1,198,881. DISPLACEMENT - PUMP. ELMER A. WATTS, Springfield, Ohio.
1,198,968. SUCTION APPARATUS. GEORGE E. STEVENS, Lynn, Mass.
1,198,909. BLAST SAD-IRON. SAMUEL GOLDSTEIN, New York, N. Y.
1,198,911. ROTARY BLOWER. MAX GUTTNER, Schmolln, Germany.
1,198,945. VACUUM-CLEANER. SANFORD A. MOSS, Lynn, Mass.
1,198,971-2. PNUEMATIC-TIRE PUMP. HUSTON TAYLOR, Chicago, Ill.
1,198,982. AIR-HEATER. SAMUEL TULLY WILLSON, Brooklyn, N. Y.
1,199,845. VENTILATING TUNNELS. DANIEL E. MORAN, Mendham, N. J.

1. Means for ventilating tunnels including in combination an outlet flue, valves between said tunnel and said flue, a motor for operating said valves and means actuated by slight variations in the pressure within the tunnel for controlling said motor.

1,199,515. AIR-COMPRESSOR. EDWARD WIKI, Lucerne, Switzerland.
1,199,567. FLUID-PRESSURE REGULATOR. RAYMOND M. KELLOGG, Mount Vernon, and JAMES K. CROWELL, Rye, N. Y.
1,199,700-1. LIQUEFYING GASES WITH A LOW BOILING-POINT. GOTTHOLD HILDEBRANDT, Spandau-Tiefwerder, near Berlin, Germany.
1,199,712. COMBINED AUTOMATIC AND STRAIGHT-AIR BRAKE. WILLIAM E. POMEROY, El Paso, Tex.
1,199,713. VACUUM-CLEANER. WILLIAM H. RAKESTRAW, Bloomington, Ill.
1,199,734. PAINTING PROCESS. CLEMENT E. DUNN, Burlingame, Cal.

1. A process of painting which comprises charging a body of air under pressure with paint by passing air through the body of paint, and discharging air from said body of air while so charged with paint against a surface to be painted.